NATURE

Vol. 141 SATURDAY, MAY 28, 1938 No. 3578

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Editorial and Publishing Offices:
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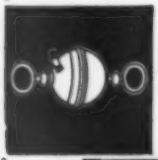

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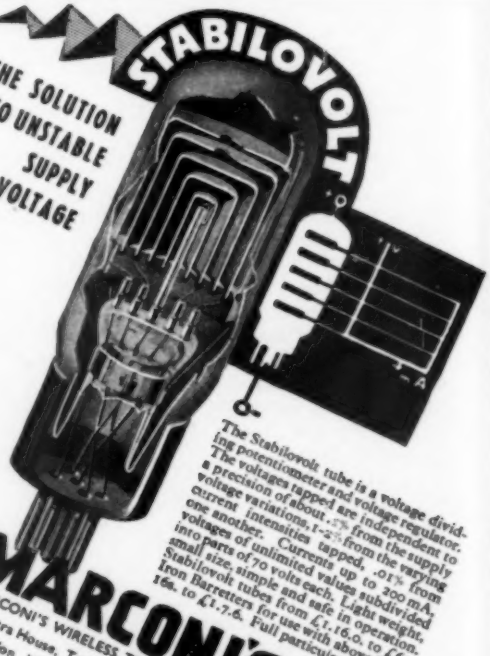

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Vol. 141 SATURDAY, MAY 28, 1938 No. 3578

Scientific Research in International Affairs

"IN the revolution of thought through which we are living, the profoundest and most disturbing element is the breakdown of that ethical system which, since the days of Constantine, has imposed upon European culture at least the semblance of moral unity." This remark made by the regius professor of Greek at Oxford in his inaugural lecture last year, was recalled by Sir Alfred Zimmern in his address at Chatham House last October on the decline of international standards. Recent events should convince the dullest mind of the extent to which international standards have deteriorated and the anarchy which threatens the repudiation of law and order in favour of brute force.

Sir Alfred Zimmern suggests that among the factors which have led to the deterioration of international standards the weakening of the Christian ethics and sanctions is significant; and there will be those ready to place upon science some of the responsibility for weakening such sanction and belief. However profound may have been the influence of science upon religious thought, the whole trend of scientific thought is in the direction of law and order, and in recent years there has been mutual recognition of the spiritual purposes of both science and religion if mankind is to regain control over events.

The present crisis places beyond question the supreme importance of some alliance of moral and scientific forces if the downfall of civilization is to be averted; and scientific workers in those centres where science still retains its freedom of thought and speech will be as united in their repudiation of the methods by which these are being repressed as they will be sincere in their sympathy for those distinguished men of science whose work and freedom are now threatened.

Outside the totalitarian States, differing political views are indeed largely determined not so much by matters of fact—though, of course, the extent to which particular holders of them have access to the facts may well vary enormously—but also, and even more important, by questions of judgment and values. It is precisely this point which was emphasized by Prof. M. Ginsberg in his thoughtful paper to the British Association at Nottingham last year. The present situation does indeed throw down yet a further challenge to the universities to play their part more fully in shaping and moulding a public opinion competent to sort out the issues and form sound judgments on questions of value as well as of fact.

In this respect, as Prof. Ginsberg has shown, the contribution of science is largely one of technique to resolve the difficulties in the way of clear, accurate and unprejudiced thought. This is, however, far from being the only contribution of science to the problem of international relations at the present time. Fully as significant is the question of painstaking and accurate research into the basic facts upon and by which decisions must be based, judgment determined and policy guided. Of the contribution which science could make in this field there could be no more admirable illustration than is offered by the study of the work of the Institute of Pacific Relations and its bearing on the problem of peaceful change, by H. F. Angus, which was issued for the Tenth International Studies Conference at Paris last June.

In this particular study, Mr. Angus is not concerned with practical issues, but he gives an impressive picture of the wide field for research which such questions as trade and tariffs, comparative standards of living, land utilization, population and migration, commercialization or

industrialization present in China and in other Pacific countries. The basic research involved in the solution of such problems has its bearing on such particular questions as the Chinese claims for the rendition of Shanghai and other settlements and concessions, for tariff autonomy and the abolition of extra territoriality, and no one can read this study without realizing how imperfect as yet are the knowledge and facts available for the decision of many of the problems the solution of which is being attempted so unhappily by force at the present moment.

It is true, of course, that research in itself can accomplish very little in promoting the peaceful settlement of disputes, and the significance of the Institute of Pacific Relations lies in the use made of its research. By referring the conflict of beliefs to the arbitrament of research, it is possible to banish the acrimony which often embitters international relations through the conflict of different beliefs held by parties to the dispute. A politician may find it necessary, in order to retain his popularity, to reiterate the beliefs generally held by his supporters. It is a different matter for him, however, to repeat the same views in quarters in which repetition will appear merely as evidence of his ignorance or his insincerity.

Part of the achievement of the Institute of Pacific Relations has been to bring international controversy into the atmosphere of scientific research, but as yet it has made no determined effort to diffuse this atmosphere among the general public by making accurate information and its thoughtful interpretation widely available. There has, of course, been a great improvement in the position here in recent years. The extent to which careful analysis has been made in the scientific spirit of the facts which lie behind the demands of a nation for an alteration of the *status quo* is being made plain by the publications of the Institute of Pacific Relations, the Royal Institute of International Affairs and other such organizations. Though the field of research is still immense, much is being done and is already available as a basis for action if Governments and nations are prepared to use the results of such research.

It is here that we reach the crucial issue at the present. The degree to which force is being accepted as the means for one-sided redress of real or imagined grievances raises new and disturbing issues, and it becomes more and more difficult to deal justly even with the original matters in dispute. The indignation raised by Japan's campaign in China, for example, leads many to overlook the genuineness of many of her grievances and the sincerity of her point of view. Sir Alfred Zimmern's address indicates how grave has been the deterioration in this field and how imperative is the work of education and of promoting a social integration between countries and groups of centres which will give the existing organization for co-operation an opportunity to function.

It is still true that public opinion remains the decisive factor in determining the conduct of foreign affairs and international relations by any Government. The Press and broadcasting and educational policy are, under modern conditions, far more potent instruments than ever before by which a Government can influence public opinion. But none the less, even in the totalitarian State, a Government can rarely proceed far in advance of the point for which propaganda has prepared its supporters, and may easily on the other hand arouse feelings which carry it far beyond the point at which it intended to halt.

It is this situation, in which nationals of one country make little or no attempt to appreciate the point of view of those of another, and do not seek to understand the reasons for one another's prejudices, that constitutes one of the greatest obstacles to international progress and co-operation to-day. International agreements, whether between individual powers or collectively through the League of Nations, have little force unless there is some common standard and measure of understanding in the minds of the parties to them. To promote such understanding and standards is of vital importance. The real significance of the admirable non-political work of the League of Nations to-day in the field of health, the settlement of refugees, the protection of women and children, the suppression of slavery and the control of the trade in opium and other narcotic drugs, or its reconstruction work like that in Austria, Hungary, Greece or in China, now interrupted by the war, like the work of the International Labour Organization, lies not less in the direct contribution offered to the relief of human suffering and distress than in the extent to which it prepares the way for understanding and good will and co-operation in a wider field.

The history of international sanctions, as revealed in the important recent study by a group of members of the Royal Institute of International Affairs, does not indeed indicate the invalidity of sanctions. What it reveals is the dangerous loose-

thinking in this subject, the widely differing standards of values and thought in different centres. It demonstrates beyond question that collective security can only function effectively when public opinion in the different countries has been educated out of its parochialism and brought to an appreciation of what is really involved in international relations in this new world, in which the forces that science has placed at our disposal have much power to build or to destroy.

Those responsible for this wise and well-balanced study were not concerned directly with the larger questions as to whether or no the attempt to establish a world order on the basis of international law should be continued. Their purpose was rather to discover how far the constitution of a system of sanctions for the enforcement of international legal obligations is a feasible proposition. To this question they give no categorical answer. The book embodying the results of their investigation marshals the facts and analyses the experience so that others may be in a position to form their own conclusions. None the less, if the weaknesses and dangers of sanctions as hitherto applied are clearly expressed, the report puts the pregnant question whether, if the world lacks the spirit of courageous and self-sacrificing co-operation on which sanctions depend, any alternative course is available whereby the calamity of war can be permanently averted. The whole trend of recent events reinforces these pleas for calm and courageous thinking, and for a moral basis for the wise and determined action which must be taken if the rich heritage of civilization as we know it to-day is to be preserved from relapse into barbarism.

The Fourth Estate

Report on the British Press: a Survey of its Current Operations and Problems, with special reference to National Newspapers and their Part in Public Affairs. Pp. ix + 333. (London: Political and Economic Planning, 1938.) 10*s*. 6*d*.

THERE could be no more appropriate time than the present for a searching examination and re-appraisal of the British Press. Over a large part of the globe, freedom of thought and of speech has disappeared; and in the countries where truth still survives, its free expression is being subjected to economic, political and social pressures never before known except in time of war. The continued freedom of the Press, once taken for granted, is by no means a certainty even in Great Britain, if the intolerable political stresses of the past two or three years are not eased soon.

Moreover, there are many in Great Britain, devoted to the cause of truth, who cannot regard the present-day freedom of the Press as an unmixed blessing. Dissatisfaction with the performance of the British Press is growing, almost as fast in Fleet Street as elsewhere. How satisfactorily does the Press inform its readers promptly, truthfully, fairly, of what is going on in the world? How seriously is it dominated by its commercial proprietors or by outside pressure-groups like the advertisers? Is it, in fact, living up to its high position as the Fourth Estate?

These are only a few of the scores of pertinent questions which the research workers of P E P (Political and Economic Planning) have sought to answer in their admirable report on the British Press, published after three years of effort. The report makes no claim to be exhaustive; indeed, its authors found the utmost difficulty in assembling the material needed for what they have modestly described as a "preliminary analysis". Too often they have had to use one newspaper office as the source of their detailed information, although they should have had the co-operation of all.

Within its admitted limitations, their work is, however, beyond praise as a severely objective study of what is at the same time a great industry, a vital profession and a public utility of incalculable importance. The report is a rich storehouse of information on every conceivable aspect of British newspapers. It tells, in astonishing detail, how newspapers are produced, how they are financed, how the news is gathered. It takes the layman behind the scenes in newspaper offices on a night when some important event "breaks" after the first edition has gone to press. Considering the speed and pressure of daily newspaper production, it is one of the miracles of modern life that they should be as complete and as accurate as they are.

Yet this report is by no means a 'white-washing' document. It at least touches upon most of the shortcomings of the British Press and finds much

cause for uneasiness. Admitting that all the British newspapers cannot and should not be remade in the image of *The Times* or the *Yorkshire Post* or the *Manchester Guardian*, the report finds particular fault with the reporting of scientific news. It doubts whether the Press "is adapting itself quickly enough to the growing output of potential scientific and industrial news and the growing demand for it". Scientific workers would do well to browse through these sections of the report; for the gulf between Fleet Street and the science laboratories is wider, perhaps, than between the public and any other field of endeavour.

"Frequently," says the report, "good stories from the laboratory and the studio are bungled and misrepresented, simply because the journalist who writes them up cannot grasp their real significance. The ability to reason scientifically, the scientist's respect for facts, is essentially the product of higher education, and it is precisely this that so many journalists have missed. . . . Really competent scientific journalists, who are both good scientists and good journalists, are few and far between, and regarded as neither fish, flesh nor good red herring by scientists and journalists alike."

In short, the British Press, with one or two exceptions, does not yet know or care to know how to report scientific news. "The public doesn't want it" is the defence of nine editors out of ten—most of them unaware of the interest in scientific news which has been built up by intelligent reporting and editing, and by the co-operation of men of science, in the United States and Canada. In Great Britain scientists (again with a few exceptions) are apt to be distrustful of the Press and have as little to do with it as possible.

The fault, as the report sees it, is fairly evenly divided, and will require conscious effort by newspapers and scientists to correct it. On the newspapers' side the chief fault appears to be the slipshod recruitment of journalists. The habit of most Fleet Street organizations is to recruit their reporters from half-educated young men who have served apprenticeships on provincial newspapers from the age of fifteen or sixteen. The editors' prejudice is to distrust specialists and to assign everyday reporters, without the slightest training in science, to 'cover' such events as the meetings of the British Association. The result is the imbecilic 'bright' reporting one encounters all too often at the time of a British Association meeting, with trivial remarks picked out of Section E or Section L to make a good headline, while announcements of outstanding importance in fields of nuclear physics or genetics or medical research are left unreported.

The remedy, therefore, lies partly in the news editors' hands. If an editor makes up his mind that the public will read scientific news, and if he assigns his best qualified reporter to find it and write it, we may yet have adequate science news in the British Press. But men of science themselves also have it in their power to correct many of the evils of which this report complains. The late Lord Rutherford was not too busy, or too eminent, to help any reasonably intelligent journalist who came to him in search of 'background' information for science news. The achievements of the Cavendish Laboratory became known throughout the world because Lord Rutherford, without self-seeking or self-advertisement, liked the world to know what he and his colleagues were doing. It requires much patience for a scientific investigator to describe an experiment to non-technical journalist in non-technical language. It calls, also, for a broad outlook which is not always found in science laboratories. But, as this report indicates, the improvement of scientific news in Great Britain is a job worth doing. For there can be no public awareness of the mighty influence and inspiration of the scientific spirit unless science makes itself known. F. K.

Sex and Society

Sex in Relation to Society

Being the first English edition of Vol. 6 of "Studies in the Psychology of Sex", abridged and revised. By Havelock Ellis. Pp. xv + 529. (London: William Heinemann (Medical Books), Ltd., 1937.) 12*s*. 6*d*. net.

HAVELOCK ELLIS'S book is a new edition, abridged and revised throughout, of the concluding volume of his monumental "Studies in the Psychology of Sex", the greatest contribution to the subject ever made by any single writer. The original edition, however, is not thereby superseded, the present one being intended for a wider public. The author points out that thirty years ago his work on the problems of sex had to be published in a way that made it accessible only to specialists, whereas since then social and legal opinion has so far changed that it can now be presented to all serious readers. This is an

important fact. For in the field of the marriage institution, only a very strong public opinion is able to effect reforms in the face of ancient entrenched traditions. Havelock Ellis says that this is particularly the case in England.

Among the reforms there is none that he has insisted on more strenuously than a change of the English divorce law. The most serious and the most profoundly unnatural feature of the ecclesiastical conception of marriage was "the flagrant contradiction between the extreme facility with which the gate of marriage was flung open to the young couple, even if they were little more than children, and the extreme rigour with which it was locked and bolted when they were inside. That is still the defect of the marriage system we have inherited from the Church". What is particularly needed is, that if a husband and wife can no longer live together, they should be allowed to part amicably, and in harmonious agreement effect all the arrangements rendered necessary by their separation; but "the law ridiculously forbids them to do so, and declares that they must not part at all unless they are willing to part as enemies".

Strangely enough, many legislators are still imbued with the idea that a marriage must inevitably end in a catastrophe, either by the death or some great misfortune of one of the consorts or by the commission of a criminal or immoral act, which is evidently regarded as a more proper ground or excuse for dissolving the marriage than the mutual agreement of both. Yet divorce by mutual consent is very ancient in European legislation. According to Roman law, a 'free' marriage could be dissolved either by mutual agreement between both parties or by the will of one party only, and divorce by mutual consent was permitted in the Roman Empire even in Christian times. The facility of such divorce remained in the Roman codes of the German kings; and those subjects of the Western rulers who elected to live under the old Teutonic systems of law seem to have had an equal facility, as is suggested by the dooms of Aethelbirht, Christian though they be. In modern times, divorce by mutual consent was reintroduced in France by the law of divorce of 1792—not, as has been alleged, by Napoleon, who on the contrary made such divorce more difficult, after that law had been in existence during twelve years. Nowadays a marriage may be dissolved upon the common application of the parties, after a short period of separation, in a few Catholic countries and in the States of northern Europe.

The present book contains twelve chapters, dealing with such subjects as sexual education, the function of chastity, the problem of sexual abstinence, prostitution, sexual morality, marriage, the art of love, the science of procreation. Each of these chapters is full of interesting and instructive facts, presented with none of the aridity so often found in scientific works, and accompanied by illuminating and well-balanced judgments, most of which every unprejudiced reader is bound to accept. In discussions of this kind, however, there is always likely to be some difference of opinion; which gives even the most appreciative reviewer an opportunity to express certain views of his own.

To the reviewer, it seems that Havelock Ellis's high estimation of sexual love—which he defines as a synthesis of lust and friendship—has made him unduly severe upon marriages contracted from other motives. He writes: "A man who marries for money or for ambition is departing from the biological moral ends of marriage. A woman who sells herself for life is morally on the same level as one who sells herself for a night." It would seem that wealth is better fitted than poverty for the biological purposes of procreation and the rearing of children, and, as Marañon remarks, a man's money is among ourselves a quasi-biological substitute for his physical ability in early times as a means of supporting his family. Further, how do the severe strictures upon mercenary marriages square with the statement that the community has no right to interest itself in the sexual behaviour of its members until a child is born or conceived, and that "it is an impertinence, if not an outrage, to seek to inquire into it?" Economic considerations are certainly of great importance at the conclusion of a marriage. Poverty may cause much hardship to the couple, and may prevent them from having children, or, if they have any, from giving them a proper education; and even some amount of wealth is not to be despised. No wonder, therefore, that economic circumstances influence very largely the choice of a partner.

Indeed, it is a very common observation that love-matches, especially early ones, easily come to grief. Schopenhauer quotes in support of his own opinion the Spanish proverb, "Quien se casa por amores, ha de vivir con dolores" ("He who marries for love has to live in sorrow"). Lord Beaconsfield wrote in his younger days: "All my friends who have married for love and beauty either beat their wives or live apart from them. This is literally the case." Bloch says "it is a well-known fact that marriages of reason are often more enduring than love-marriages". Loewenfeld points to cases of so-called "marriages of convenience" which in the course of years took on a form that converted connubial fellowship into a source of purest conjugal happiness for both parties concerned. Though love is commonly considered to be the proper

motive for a marriage, it is, after all, more important that the parties should love each other after marriage than before.

In another respect, Havelock Ellis rather seems to be too tolerant. He opposes the view that marriage is a contract in the true sense, but admits that the entrance into the world of a child should be preceded by the formation of "a marriage contract which, while in no way binding the father and mother to any duties, or any privileges, towards each other", binds them towards their child—"a contract which leaves entirely unaffected their past, present, or future relations towards other persons". How is that possible? The presence of the child certainly imposes duties on the father and mother in their behaviour towards each other, which in a very high degree affect the welfare of the child. Havelock Ellis seems to regard jealousy as a useless and stupid feeling, which, as he says, seldom makes a person more lovable, and frequently much less lovable. But if a married person behaves in a manner that causes jealousy in the other partner, the relations between them may be seriously disturbed thereby; and, as Mr. Shaw says, "an unhappy household is a bad nursery".

EDWARD WESTERMARCK.

Petrology and Mineralogy

(1) The Petrology of the Igneous Rocks
By the late Dr. F. H. Hatch and Dr. A. K. Wells. (Text-Book of Petrology, Vol. 1). Ninth edition. Pp. xx + 368. (London: George Allen and Unwin, Ltd., 1937). 15*s*. net.

(2) Elements of Optical Mineralogy:
an Introduction to Microscopic Petrography. By Prof. Alexander N. Winchell. Fifth edition, revised and enlarged. Part 1: Principles and Methods. Pp. xii + 263. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937). 17*s*. 6*d*. net.

(3) Introduction to the Study of Minerals
By Prof. Austin Flint Rogers; with a Section on Microchemical Analysis, by Dr. Lloyd W. Staples. Third edition. Pp. xviii + 626. (New York and London: McGraw-Hill Book Co. Inc., 1937). 30*s*.

(1) THE appearance of a revised edition of Hatch and Wells's "Petrology of the Igneous Rocks" is a matter of interest to British petrologists, since this has long been a standard text-book in British universities. Owing to the death of Dr. Hatch, the work is now, so far as the introduction of new matter is concerned, that of Dr. Wells, and this author has incorporated in the new edition, not only new material but also new ideas.

A most important innovation is the introduction of a new scheme of classification which, the author states, he has advocated and taught for years. Actually the scheme is, in principle, that recommended by a committee of the British Association in a preliminary report issued in the *Geological Magazine* in July 1936. This report was published with the view of attracting criticism and suggestions for the improvement of the proposed scheme, with the realization that it could only prove successful in so far as it met with general approval.

The essentials of the new classification are: (1) that the name given to a rock shall no longer carry any implication of *mode of occurrence* (for example; plutonic, hypabyssal, or extrusive); (2) that the names now proposed for the main rock types are based on, and imply a definite *grain size* for the ground-mass (ignoring phenocrysts). Only a brief outline of the new plan can be given here. Dr. Wells first divides rocks into 'clans' on a chemico-mineralogical basis. Each clan is then sub-divided into three major classes, defined in terms of grain size. One example will suffice as an illustration. The granite clan is sub-divided into granites, coarse-grained rocks of grain diameter exceeding 0·5 mm., micro-granites, with grain diameter 0·5–0·05 mm., and rhyolites, with crystals of grain diameter of less than 0·05 mm. and not exceeding 0·0025 sq. mm. in area. Mode of occurrence can still, of course, be indicated by prefixing a suitable adjective to the rock name.

The committee's report dealt only with the granite and gabbro series, and it is, apparently, Dr. Wells alone who has assumed the responsibility of publishing a complete new classification, before the committee has issued a final report. This may be one way of testing geological opinion, but it is questionable whether it is advisable to adopt, in a widely used text-book, a system not yet generally accepted. In any event it is unfortunate that the definitions of the new classification are not set out clearly, preferably in tabular form, at the beginning of each section. It would also have been an advantage for students to have indicated which are the new rock names not previously in general use.

The classification has the advantage that it simplifies the teaching of petrology, and, to some extent, if it were generally accepted, it might ultimately simplify the literature of petrology.

Judging by the fate of other attempts at reform, this seems unlikely. Dr. Wells himself, for example, still uses terms, the disuse of which was recommended by a strong committee on nomenclature so long ago as 1921.

The chapter on the metamorphism of the igneous rocks has been omitted.

So much for the changes in the book, the desirability of which is a matter of opinion. There are also certain points that call for criticism. In Part 5, on cycles of igneous activity, the section on North Wales has been considerably enlarged. This is all to the good, but in dealing with the equally interesting igneous rocks of Scotland and the Border the treatment is unequal, and Dr. Wells has not always made full use of new work. The dyke swarms surrounding the Cheviot granite are no longer regarded as radial, and a more up-to-date diagram is available. This information can scarcely have escaped the author's notice, since he actually refers to the memoir in which it appears. There is no mention of the extensive Strontian granite mass, which was carefully described a few years ago. The Permian lavas of Ayrshire are erroneously shown in two text-figures as Carboniferous. Other lavas of the same age in Dumfriesshire are not mentioned. There are one or two other defects of a like nature, of which space forbids mention.

Hatch and Wells's text-book, being so well known, attracts criticism that a less widely used book might have been spared. It only remains to state that in a new and more attractive format it still retains its character as an excellent and readable introduction to the petrology of the igneous rocks.

(2) No important changes have been made in the fifth edition of Part 1 of Winchell's well-known text-book, but a number of corrections and additions have been incorporated. Among the latter may be mentioned the inclusion of illustrations of the latest models of polarizing microscopes.

(3) The scope of Rogers's "Introduction to the Study of Minerals" has been enlarged in the third edition by the inclusion of a section on microchemical analysis. The whole work has been thoroughly revised, particularly the sections on crystallography; and the determinative tables have been enlarged by the inclusion of forty-seven additional species. A novel and useful feature of the latter section is the listing of the French and German equivalents of mineral names.

Mortality in the United States

Twenty-Five Years of Health Progress: A Study of the Mortality Experience among the Industrial Policyholders of the Metropolitan Life Insurance Company 1911 to 1935. By Dr. Louis I. Dublin and Dr. Alfred J. Lotka. Pp. xi+611. (New York: Metropolitan Life Insurance Company, 1937.)

THIS interesting volume records the experience of more than 340 million years of life, with nearly three million two hundred thousand deaths, observed in the twenty-five years 1911–35. The industrial policy holders consist mainly of urban populations at the lower level of income, so that their mortality rates would be expected to be somewhat higher than those of the whole population of the same age groups. That is, in fact, the case, but there is clear evidence of convergence, a gratifying testimony to the effects of modern sanitary progress. The trends of mortality rates for the very large number of separate causes of death examined are so similar to those of the United States where comparison is possible, that the volume may be taken as a reliable index of the changes of the last twenty-five years.

In the very large majority of instances, the secular movement in America has been similar to that in Great Britain; thus what is said in this volume of changes in mortality from tuberculosis, cancer, diabetes and cardiac diseases might be applied almost unmodified to English experience. The authors comment energetically on the black record of the United States with respect to automobile accidents and homicide. In 1934 there were more than 12,000 homicides in the United States, which, they say, "is a shocking record and places the country in the unenviable position of being the most lawless nation in the world"; and they contrast this, which gives a rate of 9·5 per 100,000, with a rate of 0·5 per 100,000 in England and Wales. Before priding ourselves too much, we should reflect that England and Wales is, areally speaking, a very small country indeed.

The authors comment with almost equal severity on the 34,000 deaths in 1934 due to automobile accidents, giving a rate more than twice that of England and Wales. But they note that 75 per cent of the world's motor cars are owned in the United States, so that we have certainly nothing to be proud of.

The volume is a most useful contribution to the literature of demography. M. G.

Les Classique de la decouverte scientifique

(1) Traité élémentaire de chimie de Lavoisier
Pp. xxxviii+191+2 plates.

(2) Leçons de philosophie chimique
Par J.-B. Dumas. Pp. xxviii+270+2 plates.

(3) La synthèse totale en chimie organique
Mémoires de MM. Wöhler, Gerhardt, M. Berthelot, Le Bel, Van't Hoff, Jungfleisch, Ladenburg, Pasteur. Préface et commentaires par Marcel Delépine. Pp. viii+144+8 plates.

(Paris: Gauthier-Villars, 1937.) 21 francs each.

IN reprinting these three classics of French chemistry with introductions, an important service has been rendered to the study of the history of chemistry.

(1) The famous "Traité" of Lavoisier, with an introduction by Le Chatelier, is reprinted in part only, but the important sections have been retained. The first part, giving the theoretical views of Lavoisier, has been reprinted in full; the second part of the original work, containing tables of compounds, has been omitted entirely, which has resulted in a few important sections being wanting, and a third part, dealing with apparatus, has been abridged. The illustrations have been incorporated in the text. The present work will serve the needs of students but it cannot be regarded as a critical edition. No indication is given as to which edition of the original has been followed for the text, and the title-page as reproduced does not correspond with either of the editions of 1789.

(2) The work by Dumas has been reprinted in full, with an introduction by G. Urbain; it is essentially historical and is still of considerable value. The style is lively and the choice of subjects is an excellent one. This volume will not only be read with profit by students but also will be useful to specialists.

(3) The volume on organic synthesis, with an introduction by M. Delépine, contains a very appropriate choice of texts in French, beginning with extracts from the registers of the Academy dealing with experiments of Bourdelin, extracts from the paper by Rouelle on urine (in which urea is first described) and from the paper describing the work of Fourcroy and Vauquelin in which this substance is first isolated, a translation of Wöhler's paper on the synthesis of urea, extracts from Gerhardt's "Traité", long extracts from Berthelot's "Chimie organique fondée sur la synthèse" and other publications by Berthelot, papers of van't Hoff, Le Bel, Jungfleisch and Ladenburg, and notes on the work of Pasteur and recent publications.

The three volumes contain portraits.

Science (K'o Hsüeh)
Vol. 22. Nos. 1 and 2 (January–February, 1938). (Shanghai: Science Society of China, 1938.) 50 cents (6*d.*).

AT this time of unparalleled unhappiness for China, it is particularly interesting to see that scientific work is going on and that sufficient support is available for the circulation of a monthly journal very similar in its aims and format to NATURE.

The January–February number, which lies before us, opens with a translation of the Mather Lecture of the late Right Hon. Ramsay MacDonald, published in NATURE of October 30 of last year. This is followed by more specialized articles, such as a mathematical paper by Mr. H. C. Wang and an account of work on pentosan fermentation by Mr. C. L. Kuo. Anthropology is represented by an especially interesting review of the geographical distribution of the "Jew's Harp" in the Orient, based on a good deal of British field work as well as on Mr. H. Liu's own researches and drawing upon the descriptions of the instruments in classical Chinese literature. Another interesting contribution is from Mr. C. F. Hsü, who lists a further thirty indigenous Chinese drugs, giving their names, characteristic place of origin, traditional therapeutic use and the nature of the active principles found in them by modern chemical methods. An appeal is made to botanists to help to identify these plants which have been known for so many centuries in the Chinese classics.

Besides these articles there are accounts of contemporary events such as the Galvani celebrations at Bologna, the ceremonies attending Prof. H. Wieland's sixtieth birthday, and various congresses. Translations of certain reviews from NATURE are also given.

The journal is printed in the modern 'scientific' style extremely well and gives an excellent impression. It should be realized that scarcely twenty years have passed since Western science began to be studied seriously in China. The application of Western science to Chinese conditions is by no means easy, since a large body of men educated in this tradition has not yet grown up. Moreover, the glaring necessities of the social situation require an emphasis on studies of immediate practical importance. Chinese scientific men are thus especially well aware of their social responsibilities. The recent discussions in NATURE of such problems, having been in the minds of Chinese scientific workers for many years past, will find a very sympathetic understanding in China. G. D. LU.

Naturwissenschaftliche Erkenntniss und ihre Methoden
Von M. Hartmann und W. Gerlach. Pp. v+70. (Berlin: Julius Springer, 1937.) 2.40 gold marks.

TWO addresses on the origin and methods of progress in biology and on theory and experiment in the exact sciences, delivered in September 1936 by Prof. Hartmann of Berlin and Prof. Gerlach of Munich before the Gesellschaft Naturforscher und Ärzte have been issued in pamphlet form, the second with considerable additions extending it to 49 pages as against 21 for the first. The aim of both addresses is to show that the methods by which science is advanced are the same in principle in all fields. In biology the methods are illustrated by the development of the chromosome theory of heredity, and in physics by the ways in which the detailed study of the physical memoirs of the last hundred years rather than philosophical discussions have made progress possible. Many examples of the way in which theory and experiment have reacted fruitfully on each other and stimulated growth are given by Prof. Gerlach, some taken from the newer, but more from classical physics.

Photographic Measurements of the Great Aurora of January 25-26, 1938

By Prof. Carl Störmer, Institute of Theoretical Astrophysics, Blindern, Oslo

THE great aurora of January 25–26 last was observed and photographed from my nine photographic aurora-stations in southern Norway. From $18^h\ 16^m$ until $6^h\ 7^m$ G.M.T., about 1,390 photographs were taken, of which about 710 were successful. Among these, there are 95 sets taken simultaneously from two stations, 48 from three and 14 from four, to determine height and position. Furthermore, about twenty spectra were secured. Besides this, I received about 180 letters with observations from different parts of Norway and about 20 from abroad. The working up of this extensive material will take a long time, but some preliminary results already obtained may be of interest.

My assistant, O. Hassel, who works without telephonic connexion with the other stations, began to take pictures as early as at $18^h\ 16^m$ G.M.T. A fine series of about sixty pictures had already been taken when the other stations began their work at $19^h\ 40^m$ G.M.T. Clouds at the eastern stations prevented good simultaneous pictures being obtained before $20^h\ 11^m$, but from that moment until dawn photographs were taken in rapid succession as fast as possible from all stations connected by telephone. The stations were combined as two sets. Each set, with the main station in Oslo, had up to three secondary stations, and the two sets worked independently of each other. The work was directed from the main stations in Oslo.

Twenty-one sets of simultaneous pictures have so far been measured and calculated. Some of the results are here brought together. Fig. 1 represents the aurora towards the south photographed from the Tömte station at 21.40.09 G.M.T. Simultaneous pictures were taken from Oslo and Oscarsborg. The arc near the southern horizon was green and persisted for a long time as the southern boundary of the aurora. Above it are seen rays which were of red colour. For a long time the northern half of the sky was quite free from any aurora. With the base-line Oscarsborg–Tömte, 73.7 km., the following heights were found: Lower border of the green arc, about 95 km. Base points of rays, from 150 to 200 km.: summits, from 500 to 600 km. The whole aurora was lying in the earth's shadow. The geographical situation of the rays measured is seen on the accompanying map (Fig. 2) over Denmark.

Fig. 1.

AURORA IN THE SOUTH PHOTOGRAPHED FROM TÖMTE, NORTH OF OSLO, AT 21.40.09 G.M.T.

The green arc was lying under the base points of the rays. The further extension of the arc eastwards and westwards could be found from single pictures taken a little before, or after, the set mentioned, the height being supposed to be 95 km. The arc was sometimes single, sometimes double, and stretched from Ösel over Denmark to the northern part of Ireland, as seen on Fig. 2.

At the same time, two other rays were photographed simultaneously from Askim and Lillehammer. With this base-line, of 173 km., the base points of the rays were found to be at about 106 km. and 108 km., and the summits about 500 km. and 540 km.

All these rays were lying in the earth's shadow, and their great length, up to 400 km. and more, is quite astonishing; it seems to indicate that the high atmosphere is lifted up by the action of the big aurora, like the lifting up by the action of the sunlight in other cases.

At 21h 41m G.M.T., the ray-summits had neared the magnetic zenith in Oslo. With the base Oslo–Lillehammer, 133 km., the summits were again measured and gave heights up to 500 km.

A fine corona next developed. The point of radiation found from the Oslo picture at 21.41.40 G.M.T. could be measured with a precision of ± 0·2° in altitude and ± 0·6° in azimuth, to altitude 70·0°, azimuth 6·4° east of south. At 21.45.34 the base points of the rays of the corona in the east were measured with the base-line Oscarsborg–Tömte, and found to be 95–105 km. (parallax, 15–20°).

During the later maximum, near midnight G.M.T., new determinations of high rays were made and heights even to about 650 km. were found for rays lying in the earth's shadow, a very remarkable fact. At 0h 14m G.M.T. the whole heavens was filled with a gorgeous corona, and it was difficult to find parts of it characteristic enough to be measured. Only the base points of some rays towards the east against the dark sky behind could be measured, and a height of about 95 km. was found. During this corona, which may be characterized as the maximum activity of the aurora in Norway that night, my assistant, Mr. Tjönn, at my station on Njuke Mountain in Tuddal, 733 metres above sea-level, reported that he heard sounds with the aurora. He says in a letter to me :

"During the imposing display of this big corona, where the whole heavens was like an ocean of flames, my assistant and I heard a curious sound which came from above, first from the south-west, then from the zenith and at last from the north-east. The sound lasted about ten minutes, rose to a maximum and fell down again, following the intensity of the aurora. I had the impression that it had something to do with the white rays. At that time I had taken off the earphones from my ears (when I had them on, I heard nothing of this sound) and went some steps aside to hear it better ; that the sound came from the telephone is quite excluded. The sound is difficult to describe, it was similar to the sound from burning grass and spray. On the mountain it was absolutely quiet, no sound coming from wind, waterfalls, telegraph lines or motors. Both my assistant and I heard it and are quite convinced that the sound was real. On the summit of the mountain where we had our station, only a few fir trees grow. Under us on all sides we had the forest."

The same sound was heard independently of Mr. Tjönn, down in the valley Tuddal, by Öystein Reisjaa, who in a letter has confirmed in all details the description given by Mr. Tjönn. When Mr. Tjönn heard the sound, he telephoned to me ; but I was so occupied by securing height determinations of the big corona that I did not pay sufficient attention to his call. On account of the great height of the aurora, it is clear that the sound could not come from the aurora itself, but from lower parts of the atmosphere ; but where its origin was future observations may decide.

A very characteristic feature of the aurora of January 25–26 was the red colour, which appeared both as diffuse surfaces occupying sometimes vast areas of the sky, and as a red glow at the top of the aurora, well seen from stations so far south as northern Africa and so far north as middle and northern Norway. This fact made it most probable that the red coloration reached enormous heights, and at 0h 35m 45s G.M.T. we also succeeded in getting simultaneous pictures of a red spot in the west-south-west from the three stations Askim, Oslo and Lillehammer on panchromatic plates, Agfa ISS. As the base-lines were almost normal to the direction to the spot, the determinations are fairly trustworthy. We found for the lowest part about 350 km., and for the summit, almost 700 km. above the earth. The spot was situated about 1,500 km. away over the Atlantic Ocean north-west of Ireland, and was quite in the earth's shadow. I am sorry that the weather prevented us from measuring the sunlit parts of this aurora early in the evening. Records of auroral heights would probably have been the result.

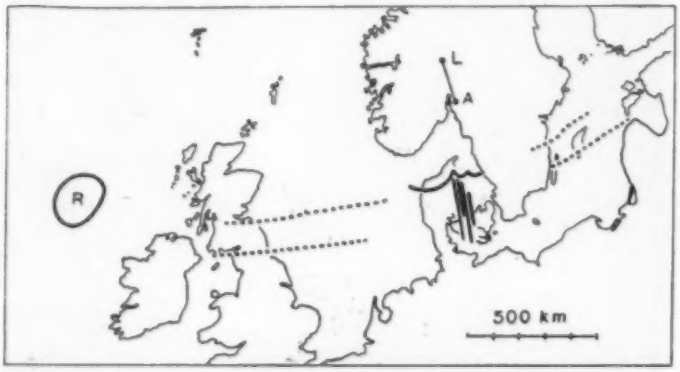


Fig. 2.

GEOGRAPHICAL SITUATION OF AURORAL ARCS AND RAYS AT ABOUT 21h 40m G.M.T. AND OF A RED SPOT (*R*) AT 0h 35m 45s. THE DOTTED LINES ARE FOUND FROM SINGLE PICTURES SUPPOSING THE LOWER BORDER OF THE ARCS EQUAL TO 95 KM. *L–A* IS THE LONGEST BASE-LINE, LILLEHAMMER–ASKIM, 173 KM.

Among the spectra taken by my assistant, Herlofson, only a few need be mentioned. On the same Agfa ISS plate were taken two spectra when the spectrograph was pointed towards the green arc in the south mentioned in the first part of this report. They show the green line 5577 A. as the strongest; then come with decreasing intensity the lines 6300 A., 6550 A. and 4278 A. On the same plate were taken two spectra when the spectrograph was pointed towards red areas. They show 6300 A., by far the strongest, next 5577 A. and faint traces of 6550 A. and 4278 A.

On Agfa red ultra-rapid plate was taken with the same spectrograph a spectrum of the red colour in the southwest between $0^h\ 10^m$ and $0^h\ 30^m$ G.M.T. Here 6300 is again by far the strongest line, then 6550 and 5577 about equally strong, and traces of 4278. On the same plate were taken spectra of pulsating auroras and corruscations between 2^h and 4^h G.M.T., situated in the height interval from 90 to 120 km. Here all four lines have about the same intensity.

Photometric measurements of these spectra will be made later.

Medical Research in Great Britain

THE report of the Medical Research Council for 1936–37* gives, in summary form, an account of the researches carried out by members of its staff, either at the National Institute for Medical Research or in external institutions, as well as by the numerous investigators, working in different laboratories, who receive grants-in-aid from the Council. In this report, separate sections are devoted to the work carried out by members of the Council's staff in external institutions, instead of its being included in the sections also describing the investigations aided by grants, in order to give a truer picture of the organization of the Council's activities.

Lord Mildmay of Flete, treasurer of the Council, resigned his membership during the year; Mr. Goodenough was appointed to succeed him. Sir Thomas Lewis and Sir David Wilkie retired in rotation and were succeeded by Prof. Gask and Prof. Witts. The Council has made appointments to Dorothy Temple Cross research fellowships, to research fellowships in tropical medicine and also to Rockefeller medical fellowships. It will be recalled that last year it was announced that the Rockefeller Foundation had suspended the arrangement under which the Council awarded these fellowships, as it wished to concentrate its activities on certain selected fields of medical research: the Foundation has, however, now generously agreed to restore and augment the former arrangement. The Council has continued to maintain close touch, at relevant points in its work, with the Government departments concerned with questions of health and has also been closely concerned with international health work under the League of Nations, and especially with regard to questions of nutrition and of biological standards, upon the Commissions dealing with which it is directly represented.

The need for additional laboratories for work on chemotherapy and biological standards and for nutritional studies as well as to relieve the present overcrowding at the National Institute for Medical Research has led the Council to consider the possibilities of development at the present site at Hampstead and at the site of the farm laboratories at Mill Hill. Owing to the fact that the Hampstead site has been reported on as unsuitable for further development on the scale which is now in view, even without allowing any margin for future expansion, the Council has decided in principle to abandon this site and to concentrate the whole of the National Institute at Mill Hill. A final decision can be taken only in the light of a definite estimate of the cost, based on the detailed plans which are now being worked out. If the project can be undertaken at once, it should be possible to complete it within about two years, and to provide additional accommodation for some purposes at an earlier date.

The grant-in-aid provided by Parliament for the expenditure of the Medical Research Council was greater by £30,000 than the amount in the previous year, the difference representing special provision for the development of research work in chemotherapy. Chemotherapy is the treatment of infective diseases by the administration of chemical compounds synthesized in the laboratory, which have been found to have specific actions on the infective organisms associated with these diseases. The principal successes of this form of treatment have so far been in infections with spirochætes and protozoa rather than with bacteria, in venereal and tropical diseases rather than in the bacterial infections common in a temperate climate. Quite recently, however, success has attended the use

* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1936–37. Pp. 165. (London: H. M. Stationery Office, 1938). 3s. net.

of the sulphanilamide group of drugs in streptococcal and other infections, thus opening up a new field of chemotherapy, which is being rapidly and effectively developed.

Although this is the usual sense in which the word "chemotherapy" is employed, there is a much wider field of medical treatment in which advance depends on the same kind of investigation, made by chemists and biologists working in close collaboration. In this field is included the discovery of chemical substances which have specific actions on certain bodily functions, and therefore great value in the systematic treatment of disease. The Council points out that the discovery of chemical compounds of this nature has depended almost entirely on German science and industry, and still so depends, although several fundamental discoveries were made in Great Britain. There is therefore great need for further research in Great Britain aimed at the discovery of new chemical substances of therapeutic value, and strong reason for developing a national scheme of investigation not unworthy of comparison with the work that is done abroad, especially considering that the British Empire is the chief consumer of drugs used in the treatment of tropical diseases. The financial requirements of an effective scheme are too large to be met from the ordinary resources for medical research, so that it can only be supported by funds specially provided as a matter of national policy. In Germany, the research work has been mainly carried out in institutions maintained by manufacturing chemists: in Great Britain the interests of the larger firms have lain in other directions, and the smaller firms have been content to act as agents for the foreign producers. In the absence of the necessary expansion of chemical industry, the only possibility of securing that Great Britain takes its proper part in this matter, in relation to its imperial responsibilities, is a national scheme supported from public funds.

For some years, the Council has supported research work on chemotherapy at different centres and valuable results have been obtained; witness the recent discovery of the trypanocidal properties of compounds with terminal iso-thiourea and amidine groupings. Notwithstanding the results obtained under the present scheme, it had become clear that improved research facilities were needed to secure substantial advances in chemotherapy from the point of view of the ultimate practical effect on diseases inaccessible to other forms of treatment, and especially on the major problems of protozoal infections in the tropics. It is considered that a central research laboratory is an essential factor in a national scheme: it will provide for the close association of the biological investigators with those engaged in the synthetic production of new compounds: and it will provide mass data from which it may be possible to discover laws relating chemical structure to therapeutic effect, so that research in this field will become less empirical than it is at present.

The main part of the report is devoted to short accounts of the researches carried out by members of the Council's staff or by workers assisted with grants-in-aid; but certain subjects are selected for more detailed consideration in the introduction, of which two have been referred to above. Among others may be mentioned influenza and the study of viruses, the surgery of the heart, the causes of mental defect, the role of salt in the body, the diagnosis of cholera and the experimental study of leprosy. It is now known that the virus of influenza is multiple, that responsible for the 1933 epidemic being of a different strain from that isolated in the 1936–37 epidemic. Hence, if vaccination is to have the best chance of success in any future outbreak, it will be necessary to choose an inoculum made from a virus belonging to the same immunological group as that responsible for the immediate outbreak. Experiments with ferrets suggest that such vaccination may successfully prevent the ordinary human contact infection. The discovery that many viruses will grow in the chorio-allantoic membrane of the developing chick provides an experimental method of research into their properties, which is simpler and more precise than that involving inoculation of laboratory animals. It is possible that the egg-culture technique may be used in the future for producing vaccine to protect against smallpox on a large scale, thus superseding the lymph of infected calves.

An interesting account is given of recent experimental work on the surgery of the heart and its application to cases of heart disease in man. Vascular obstruction in the heart cannot ordinarily be remedied as in most other organs by the development of a collateral circulation: it has been found, however, that the great omentum can be brought up from the abdomen through the diaphragm and secured to the heart, when new blood vessels will grow into the heart muscle from it. Several patients have now been operated on and only one may be considered to have died as the direct result of the operation; the survivors are all improved and some formerly bed-ridden patients are now leading a life of normal activity. About a quarter of the patients operated on only survived a few months, but it is pointed out that individuals suffering from diffuse disease of the vessel walls in the heart are in any event liable to sudden death; two in fact died suddenly a few days before the date on which the operation had been arranged for them.

The discovery that the bacillus of rat leprosy can be transmitted to the Syrian hamster, has been followed by the announcement from Palestine that this species can be similarly infected with the causative organism of human leprosy. This work should provide the basis of a new attack on the problems of this disease, and, in particular, make possible the experimental study of the treatment of leprosy by chemotherapeutic methods.

A few only of the subjects dealt with in the report have been selected for notice in this review: for a fuller picture of the Council's activities reference must be made to the original. It may be mentioned that full titles and references to the original papers published by members of the Council's staff and other investigators are given throughout the report, so that those interested can easily obtain the further details they require.

The Linnæan Tradition

FOUNDED ten years after the death of the celebrated Linnæus, the Linnean Society of London has for the past hundred and fifty years carried on the work he initiated in systematic botany and zoology. The anniversary was celebrated in London by appropriate meetings on May 24–27. Without any doubt the founding of the Society was due to the presence of the Linnæan Collections in England in 1784, in which year they had been received by purchase from Linnæus's widow by James Edward Smith, a medical student then twenty-four years of age. That close contact with the materials used by the great Swede resulted in the English naturalists adhering very closely to what may be called the Linnæan tradition; and although the systems used by Linnæus have been greatly changed or superseded, it is significant that his authority and influence are still felt strongly to-day.

The tradition left by Linnæus was indeed a great and a worthy one. Despite the carping criticisms of certain historians, there is no doubt at all that Linnæus wrought a great and fundamental work in both botany and zoology. Concentrating his efforts on the classification and description of plants and animals, he did the task most needed for his time; leaving a vast body of completed work, and, as the result of his deep and sincere thought, methods which are followed in the main by taxonomists to-day. Looking across two centuries, we can visualize that short sturdily built man with his keen-sighted brown eyes and his open and pleasant face, who worked from boyhood to old age with singleness of purpose towards one objective—to know and classify all forms of living organisms. No living organism can be named correctly until it is known; none known properly until it is classified correctly.

Linnæus's achievements in botany and zoology can be gauged rightly only when considered in relation to the states of those sciences at the time when he worked. He came at a time when Western naturalists had succeeded in disentangling themselves from the ancient authority and superstition that had clung to them long after the Renaissance. Men had turned from the authority of books to study Nature; from travels and exploration more new plants and animals were becoming known each succeeding year; attempts were being made to present in systematic form the knowledge then extant; but the net result had been a chaos in which each worker had put forward his own ideas of system and nomenclature.

Coming at the very time when he was urgently needed, Linnæus, clear-headed, practical, imaginative, resolved that chaos into order. Although so early as 1738 he had published in "Classes plantarum" a sketch of a natural system in botany, and throughout his life continued to elaborate it, his botanical works were always arranged according to the sexual system, which he had devised when he was twenty-four years of age. His reason for adhering to that system was a sound one: at the time he worked, an insufficient number of plants were known to found properly a natural system. Nevertheless, his own system brought together automatically some of the natural groups; and when the rise of the natural system began with the work of the de Jussieus, Robert Brown and others, much of Linnæus's work on genera and species still held good. In zoology, also, Linnæus's influence continues in spite of changes of system.

The Linnean Society's early history reflects most clearly that almost religious adherence to the Linnæan tradition; but the rise of the natural system in botany, the impact of the Darwinian theory of natural selection, the influence of the great school of German physiological botanists, or the specialistic developments of modern biology, have not obliterated that tradition. None of these waves of influence could or can sweep away the ultimate necessity of presenting the facts of Nature in taxonomic form. Under his will, Darwin left a sum of money to be devoted to the

compilation of a great index for the use of taxonomists, the "Index Kewensis"; the aim of the German physiologists was to find a better basis of taxonomy (one of the negative results of which is that to-day real systematic botany is but scantily touched upon in British universities); and the efforts of the ecologists, geneticists and cytologists can have but one real object—the ultimate reclassification of living organisms.

Among the tendencies of the present time, it is possible to detect an impatience with the existing forms of taxonomy; but any attempt to alter such forms without very profound consideration and fair trial would seem likely to lead to a chaos similar to that from which Linnæus rescued the learned world. Often without being able to read with any ease the Latin works of the older naturalists, some of the modern workers appear to be inclined to cut adrift entirely from the past. The remedy surely lies in a more careful consideration of the philosophical ideas upon which all taxonomy must be based.

A Discontinued Darwin Medal

By T. E. James

THE rise and mutual development in Great Britain of provincial natural history and literary societies, microscopical clubs and field clubs is one of the stories of nineteenth century science that scarcely requires iteration. Yet in regard to one of these, the Midland Union of Natural History Societies, an amalgamation of 1878, due in the main to the efforts of Mr. Lawson Tait, F.R.C.S., of Birmingham, there is a connexion of Darwinian interest in the Union's institution of a Darwin Medal, which in course of time has lapsed in award, and possibly is now altogether out of mind.

The medal bore on the obverse the portrait-bust of Charles Darwin in bas-relief and the reverse a branch of coral; while the medal itself was the work of Joseph Moore (1817-1901), a well-known medallist-sculptor and die-sinker in Birmingham.* Why the award of this medal ceased will be considered presently. Apart from the Royal Society's Darwin Medal (the first award of which was not made until 1890), there would appear now to be no medallic gift in Great Britain which periodically commemorates the researches of the great naturalist in this way.

The idea of an amalgamation of the numerous scientific and literary societies already existing in various parts of the Midland counties took practical shape in 1878 as above mentioned, and a journal called the *Midland Naturalist* was started as the organ of the Union; the journal appeared successfully down to the end of the year 1893. It was an effective and highly popular medium of intercommunication, but like other official fusions of the period, strength of membership carried latent weaknesses. The magazine eventually became an onerous task, its issue resting on the efforts of the zealous minority.

Returning to the Darwin Medal of the Midland Union, it appears that at the annual meeting held in 1880 at Nottingham, a suggestion was made by Mr. W. Jerome Harrison for the foundation of a yearly prize which should have as an objective the encouragement of original research connected with the natural history of the Midlands. Regarded favourably, it was unanimously agreed to institute an annual Darwin Prize of the value of £10, to include a gold medal denominated the Darwin Medal, for a paper embodying original research contributed by a member of the Union for publication in the *Midland Naturalist*. Incidentally, it may be said that Charles Darwin was a subscriber from the first to this publication.

DARWIN MEDAL OF THE MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

Steps were taken to acquaint Darwin with the proposal and to ask his permission to adopt his name. Darwin replied as follows:

"I request that you will be so good as to inform the members of the Committee that their wish to name the medal after me is a very great honour, which I gladly accept. It is particularly pleasing to me to have my name connected, in however indirect a manner, with a scheme for advancing science—the study of which has been my chief source of happiness throughout life."

* Joseph Moore also designed a medal for the British Association meeting at Birmingham in 1849 and at Cheltenham in 1856.

This cordial letter is not recorded in the "Life and Letters"; but somewhere perhaps the original may be in existence.

Regarding the provision of regulations for the "Darwin Prize", it was decided that the subjects for each of the three years ensuing should be geology, zoology and archæology. The following committee of five adjudicators was chosen: Dr. Thomas Wright, the Rev. George Deane, Prof. Charles Lapworth, J. J. Harris Teall (afterwards Sir Jethro Teall) and W. Jerome Harrison. The first recipient of the gold medal, for the year 1881, was Edward Wilson, of Nottingham, for his paper "The Permian Formation in the North-east of England". The award for the year 1882, in zoology, went to Prof. A. Milnes Marshall, M.D., and W. P. Marshall, M.Inst.C.E., for their joint paper on the "Pennatulida". Space forbids naming the adjudicators. The medal was presented at the annual meeting held at Tamworth in June 1883.

At this meeting it was reported also that a bronze copy of the medal had been sent to the family of the late Charles Darwin, and that Mr. W. Erasmus Darwin, writing from Basset, Southampton, on December 14, 1882, had expressed the opinion that it embodied a striking likeness of his father, who had much appreciated its foundation.

Awards continued, mostly yearly, but always subject to the receipt of meritorious papers. Mention may be made of the annual meeting of 1889, held at Oxford, with Mr. (now Sir Edward) E. B. Poulton, F.R.S., as president of the Union. His address bore the title "Theories of Heredity". We hear of "trenchant criticism" of the word "heredity" by Lawson Tait, and a "lively passage of arms" thereon with Francis Galton. The Darwin Medal for the year was handed to T. W. Walker, for a thesis on a geological subject.

So far back as 1882 a note of warning had been given in the *Midland Naturalist* that an endowment fund of £250 would be required if the gift of a gold medal was to continue as a permanent memorial. Alas! this object was never achieved; the Union sailed over uncharted and uncertain waters, and some indeed of its constituent bodies were bad sailors in Darwinian days. The *Midland Naturalist* ceased publication at the close of 1893, and the Darwin Medal became a final award in 1895 with its allocation to Dr. Walter E. Collinge, now keeper of the York Museum, for studies in comparative anatomy.

Obituary Notices

Mr. Hugh Ramage

THE death of Mr. Hugh Ramage, on April 16, at seventy-three years of age, will be deeply regretted by all who knew him. He was one of the most unassuming of men, yet his work in certain fields of spectroscopy was of a very high order, and his devotion to these studies in the leisure hours of a busy life manifested a spirit of self-sacrifice in the pursuit of scientific knowledge not often found at any time.

Mr. Ramage was born on March 31, 1865, at Wolverton, Bucks, but both his father and his mother were natives of Catrine, Ayrshire. He left school at twelve years of age, and a year later, after his parents had removed to Crewe, he entered the L.N.W.R. carriage works there in the telegraph office, his duties being to work the single needle telegraph instrument. While in this position, and afterwards when he became an apprentice in coach-making, he attended evening classes in elementary scientific subjects and mathematics at the Mechanics' Institute. Probably on account of these studies, he was eventually transferred to the laboratory of the locomotive works and became engaged in analytical work. When twenty-one years of age, he entered for the annual competition for National Scholarships or Royal Exhibitions, then awarded on highest successes in the Science and Art Department's examinations. As the result, he obtained a Royal Exhibition tenable at the Royal College of Science, Dublin, which he entered in October 1886.

After completing his course at the Royal College of Science, Mr. Ramage returned to the Crewe laboratory in 1889 under Joseph Reddrop, and while there carried out investigations on the bismuthate method of estimating manganese and the estimation of phosphorus and carbon in mild steels. He left Crewe in 1891 to become demonstrator in chemistry under Prof. (afterwards Sir Walter) Hartley at the Royal College of Science, Dublin; and in the following year he began to assist Sir Walter in researches on flame spectra. One of the chief objects in view was the study of Bessemer flame spectra; and the results obtained were valuable contributions to the knowledge of the thermo-chemistry of the Bessemer process. It was in conjunction with Mr. Ramage that Sir Walter Hartley discovered the existence of the bands in the flame spectra of many metals and from a study of these was able to draw important conclusions about the relation between the band and line spectra of the same element.

Mr. Ramage's introduction to the use of the spectroscope in chemistry in association with Sir Walter Hartley determined his main scientific interests and activities throughout the rest of his life. In 1899 he left Dublin and went to Cambridge

as a research student, Prof. Liveing giving him facilities for work on the oxyhydrogen flame spectra of metals, especially the band spectra of copper, silver and gold, but also of other elements, and to study homologous lines in spectra and relationships between wave-length or wave-number and atomic weight. In his ninth term he submitted two theses to the Board of Studies and obtained his degree upon them. Three years later, in 1904, he was appointed organizer of higher education and principal of the Technical Institute at Norwich, out of which developed the Norwich Technical College, of which he was the principal until his retirement in 1930.

Mr. Ramage was the author, or joint author, of a number of papers published in the proceedings or transactions of societies and in scientific journals. Reference has already been made to his work with Reddrop, with whom he was associated in his first paper published by the Chemical Society in 1895, on the volumetric estimation of manganese by oxidation with sodium bismuthate, which is now in general use. From that date until 1901 he was the joint author, with Sir Walter Hartley, of fourteen papers contributed to the Royal Society, Chemical Society, Iron and Steel Institute and other societies, on spectrographic analysis of various minerals and metals and related subjects. Among the subjects of similar papers of which he was the sole author are the spectra of potassium, rubidium, cæsium and their mutual relations, abnormal changes in some lines in the spectrum of lithium, and the distribution and spectra of metallic vapours in electric sparks. He also discovered that Norwich flue-dust was a source of gallium.

In recent years, Mr. Ramage devoted chief attention to the use of the spectroscope to biology and medicine, and his researches in this field are of particular importance. Some of the most interesting of these were published as communications to NATURE, and others appeared in the *Biochemical Journal*. The first account of results obtained by Mr. Ramage in his extension of spectrographic analysis to vegetable and animal matter seems to have been given by him in NATURE of April 20, 1920. This was followed, in the issue of August 23, 1930, by a communication on such an analysis of mushrooms, which showed that each part had a high potassium and a low calcium content. Copper and silver were also shown to be contained in different parts of a mushroom. (In August of last year Mr. Ramage extracted from half an ounce of dried mushrooms in powdered form a tiny pellet of silver and a similar one of copper.) In NATURE of November 1, 1930, a joint communication from Prof. Munro Fox and Mr. Ramage summarized the results of a survey of animal tissues with the view of detecting and analysing quantitatively those of the less common elements contained in protoplasm and its products capable of being investigated by spectrographic methods. A paper on this subject by Fox and Ramage was published in the *Proceedings of the Royal Society* in the following year. It was shown by these studies that manganese was widely distributed and that the manganese content of animal tissues varied with the locality in which a given species of animal lived. Further work showed that strontium occurred in the genital duct of the edible snail and that manganese was a prominent element in its liver. Copper and iron were always detected; and silver was present in the kidney and liver of all crabs and lobsters examined. Similar methods were applied to the study of the composition of human tissues, the results of which appeared in the *Biochemical Journal* and the *Proceedings of the Royal Society*. Among other results, this work led to the first description of the presence of barium in the human choroid.

The essential importance of small amounts of mineral constituents in soils, as affecting the growth of both plants and animals, is now fully recognized, and the researches carried out by Mr. Ramage himself, and in association with others, upon the occurrence of such elements in plant and animal tissues have proved to be of greater practical value than was ever anticipated by him. He played an important part in the study of a deficiency disease of sheep in Australia, which ultimately proved to be curable by cobalt, by virtue of his discovery that the soil in the affected areas was deficient in this element. The sole motive of his scientific work was to increase his own knowledge of natural actions and phenomena, and to present the world with the results obtained, whether they were of practical use or not. In this respect he represented the noblest type of the scientific spirit.

While attending the Toronto meeting of the British Association in 1897, Mr. Ramage met Miss Winifred Pye-Smith, who became his wife in 1904 and survives him, with one son and one daughter.

Sir Wolseley Haig, K.C.I.E., C.M.G.

WE regret to record the death of Sir Wolseley Haig, distinguished as soldier, administrator and orientalist, which took place on April 28, at the age of seventy-two years.

Thomas Wolseley Haig was a son of Major Robert Wolseley Haig, of the Royal Artillery and fellow of the Royal Society, and was born on August 7, 1865. He was educated at Wellington College and Sandhurst, joining the Seaforth Highlanders in 1884. He transferred to the Indian Army and was engaged in the suppression of the dacoits of Upper Burma. His appointment in 1892 as a member of the Berar Commission, which was entrusted with the Assigned Dominions of the Nizam, brought him into close touch with the life of the Deccan and turned his interests to the study of its history and linguistics. After holding various administrative posts there, he entered the Political Department of the Government of India in 1901, serving at Hyderabad, at headquarters, and at Alwar, where as political agent he exerted great influence over the somewhat difficult Maharaja. His final term of service in the East, from 1910 onward, was passed mainly in Persia. He served in a consular capacity at various posts, including Baluchistan, Khorasan and Ispahan, to the last-named of which he was transferred in 1916, and

where he was associated with General Percy Molesworth Sykes, who speaks highly of his abilities and achievement in dealing with Eastern peoples in his "History of Persia". In 1920 he retired, having received the orders of the Star of India, St. Michael and St. George, and the British Empire. In 1922 he was created K.C.I.E. In 1923 he accepted an heraldic appointment in Scotland. He resigned the office of Albany Herald in 1935 on the ground of ill-health.

As an oriental scholar, Sir Wolseley Haig will be remembered chiefly for his contributions to Indian history and for his detailed knowledge of Moslem rule. As a translator his version of Badaoni's history, one of the chief sources for Akbar's reign, is the standard of reference. He also translated the *Burhan-i-Maasir* of Tabatabai, the principal source for the Nizam Shahi dynasty of Ahmadnagar. On his return to England, Sir Wolseley was appointed professor of Arabic, Persian and Hindustani at Trinity College, Dublin, and later was lecturer in Persian in the School of Oriental Studies, London. He was also joint editor of the "Cambridge History of India", the third and fourth volumes, covering the whole Moslem period, being allotted to him. The third volume was largely his own work; but owing to a breakdown in health, after he had planned the fourth volume and prepared voluminous notes, the completion of the volume fell to Sir Richard Burn.

News and Views

Prof. J. J. Abel, For. Mem. R.S.

PROF. JOHN JACOB ABEL, who has just been elected a foreign member of the Royal Society, is the doyen of American pharmacologists. He is one of the best known and widely beloved personalities in medical science, in his own and other countries. After graduation, he worked under C. Ludwig in Leipzig and O. Schmiedeberg in Strassburg. Returning to the United States, he became professor of pharmacology at Ann Arbor, Michigan, migrated from there in 1893 to be the first professor of pharmacology at the Johns Hopkins Medical School, Baltimore, and held this chair with great distinction for nearly forty years. Prof. Abel's direct contributions to science have been chiefly on the chemical side of pharmacology. He was the first to bring to practical completion the isolation of epinephrine (adrenaline); later he discovered the same substance in the skin glands of a South American toad, from which he also isolated the toxic principle 'bufagin'; and he was the first to crystallize insulin. Among many other achievements, he devised methods for studying the diffusible constituents of the living blood, and the reconstitution of its plasma after hæmorrhage. Even in his retirement he is actively engaged in new and important researches on tetanus toxin. Throughout medical science in the United States his influence has been spread by his pupils, inspired by the example of a long life of selfless devotion to the pursuit of knowledge.

Prof. N. E. Nørland, For. Mem. R.S.

AN unusually wide circle among men of science, including mathematicians, astronomers and geodesists, will approve and appreciate the election of Prof. N. E. Nørlund to the foreign membership of the Royal Society. Prof. Nørlund has since 1923 been the director of the Danish Geodetic Institute, an office always previously held (as in the case of the Ordnance Survey in Great Britain) by a military officer. In recent years, he has undertaken a new first-order triangulation of Denmark, and in Greenland also he has instituted a new triangulation which will extend up to 76° N.—a most valuable contribution to the determination of the figure of the earth. In mathematics, his works include memoirs on the theory of difference equations in the complex domain; on divergent series; and on continued fractions. In astronomy, at the University Observatory of Copenhagen, he has worked especially on the errors which affect the meridian observations of fixed stars, and has also made an important study of the double star ξ Ursæ Majoris, concluding from a very slight perturbation in its orbital motions that it is a triple star, the observable pair having an invisible satellite. Prof. Nørlund has held many distinguished offices in his own country, and has played a prominent part in the international organization of science; he has presided over the Baltic Geodetic Commission, the International Time Commission, and the International Council of Scientific Unions. He is a foreign member of the Academies of Science in Paris, Rome (Lincei) and Stockholm, and an associate of the Royal Astronomical Society.

Prof. René Leriche

THE Lister Medal for 1939, which is awarded in recognition of distinguished contributions to surgical science, has been awarded to Prof. René Leriche, professor of clinical surgery in the University of Strasbourg, and he will deliver the Lister Memorial Lecture in 1939 at the Royal College of Surgeons of England. Prof. Leriche, who was born on October 12, 1879, received his medical education at Lyons, taking his degree in 1906. In 1906–9 he was chief of the surgical clinic of the Lyons hospitals, and then became full surgeon. In 1920 he became lecturer in experimental surgery at Lyons, and has also held there the professorship of external pathology. In 1924 he was appointed to the chair of clinical surgery

in the University of Strasbourg which he now holds. He was made an honorary fellow of the Royal College of Surgeons of England in 1937. Prof. Leriche is chiefly interested in the surgery of the stomach, bones, joints, the sympathetic system, and diseases of arteries. This is the sixth occasion of the award, which is made by a Committee representative of the Royal Society, the Royal College of Surgeons of England, the Royal College of Surgeons in Ireland, the University of Edinburgh, and the University of Glasgow.

Dr. D. T. A. Townend

DR. D. T. A. TOWNEND has been appointed Livesey professor of coal gas and fuel industries in the University of Leeds. After nearly four years of war service, Dr. Townend entered the East London (now the Queen Mary) College, London. He graduated in 1920 and then proceeded to the Department of Chemical Technology at the Imperial College of Science, London, for post-graduate study and research under Prof. W. A. Bone. He has since collaborated with Prof. Bone more particularly in investigating gaseous explosions at high initial pressures. Dr. Townend was awarded successively a Salters' research fellowship and a Rockefeller international research fellowship. He has been largely concerned in the equipment and organization of the High Pressure Laboratories at the Imperial College. Dr. Townend, who is a recognized teacher in the University of London, is an authority on combustion and high-pressure problems and has published many books and articles both independently and in collaboration with his colleagues at South Kensington.

U.S. National Academy of Sciences: New Members

AT the annual meeting of the U.S. National Academy of Sciences held on April 25–27, the following were elected foreign members: Prof. Alfred Fowler, emeritus professor of astrophysics, Imperial College of Science and Technology, London; Prof. Pierre Janet, professor of psychology, Collège de France, Paris; Dr. S. P. L. Sorensen, director of the chemical division of the Carlsberg Laboratory, Copenhagen; and Prof. D. M. S. Watson, Jodrell professor of zoology and comparative anatomy, University College, London. The following members were also elected: Prof. M. H. Stone, professor of mathematics, Harvard University; J. A. Fleming, Department of Terrestrial Magnetism, Carnegie Institution of Washington; Dr. C. D. Anderson, California Institute of Technology; Prof. G. W. Stewart, professor of physics, University of Iowa; Prof. Theodor von Kármán, director of the Daniel Guggenheim Laboratory, California Institute of Technology; Prof. W. K. Lewis, professor of chemical engineering, Massachusetts Institute of Technology; Prof. C. S. Marvel, professor of organic chemistry, University of Illinois; Prof. W. H. Rodebush, professor of physical chemistry, University of Illinois; Prof. W. H. Bucher, professor of geology, University of Cincinnati; Prof. L. J. Stadler, professor of field crops, University of Missouri; Prof. T. S. Painter, professor of zoology, University of Texas; Prof. W. de Berniere MacNider, professor of pharmacology, University of North Carolina; Prof. E. Adelberg Doisy, professor of biochemistry, St. Louis University; Prof. S. B. Wolbach, professor of pathological anatomy, Harvard University; Prof. L. L. Thurstone, professor of psychology, University of Chicago.

Metal-Mining Enterprise

SIR WARINGTON SMYTH was the first professor of mining at the Royal School of Mines, and his forty years of service coincide with one of the most momentous changes in the history of the world, namely, the growth of industry on a metallic foundation. Prof. S. J. Truscott showed, in his Warington Smyth Memorial Lecture delivered on May 5 (Pp. 38 + 2 plates. London: Macmillan and Co., Ltd. 1*s*. net) how to-day everything civilized man enjoys depends on metals; without them rapid transport, modern housing, preservation of foodstuffs, etc., are impossible. Metals are durable as contrasted with vegetable and animal products, which are used once, whereas metals can be and are refabricated. The annual production of fresh supplies of metal merely augments the amount already in use, an amount greater in value than the total of all other commodities utilized by man. Metals, with the exception of gold, are not found to any extent as native metal and have to be extracted from highly complex ores. The enterprise of the miner has made many valuable discoveries such as the Bessemer process for ferrous metallurgy, the McArthur cyanide process for precious metallurgy and the flotation process for the base metals, and probably the same enterprise will find a cheap method of producing the light metals such as aluminium and magnesium. Further enterprise has rendered available vast sources of minerals which would otherwise have remained valueless, and in addition has shifted the centre of production of certain metals, for example, copper, from one continent to another. As the result of the exploitation of these processes combined with similar advances in engineering technique, one part of gold in 200,000 is being won at a profit, and one hundred million tons of base metal minerals are being treated by the flotation process per annum.

Mining Engineering as a Profession

IN his presidential address delivered on May 19 to the Institution of Mining and Metallurgy, Dr. C. B. Kingston discussed "Mining Engineering as a Profession". He said that mining is essentially a man's job and offers a splendid career to the keen ambitious man who is not seeking security first but likes a spice of adventure and finds satisfaction in a constructive occupation that makes some definite contribution to the world's welfare. The training of a modern mining engineer should be based on a sound general education, as not only must he be a technician but also in addition a man of affairs, a competent negotiator and preferably a linguist. The technique of mining is difficult to define, as it is all-embracing in its requirements, but briefly it can be described as the application of all the applied sciences to finding, winning and subsequent preparation for the market of a mineral deposit. The increasing importance

of metal in the world's affairs is creating further demands on a mining engineer's accomplishments in an ever-widening field of activity and with larger-scale operations than ever before. A study of history, ancient and modern, in terms of minerals is fascinating because the growth of nations and the cause of many wars cannot be dissociated from the possession or a determination to secure control of high-grade deposits of essential minerals. The question has been asked, "Who owns the earth?", and the answer given is "The nation which controls the greatest mineral resources."

Roman Wroxeter

RECENT excavations on the site of the Roman city of Uriconium, which lies beneath the modern Wroxeter, five miles from Shrewsbury, were described by Miss Kathleen Kenyon, the field director of the excavation, at a meeting of the Society of Antiquaries of London on May 12. Some years ago excavations were carried out with the object of determining the position and character of the defences of the legionaries' camp, but without success, nor has investigation been more successful on the present occasion. Much information, however, has been obtained about the history of the city. It would appear that Uriconium, which was the fourth largest Roman city in Britain, was founded about A.D. 48 as the headquarters of the Fourteenth and Twentieth Legions, of which it was the station while Wales was being subdued. When the legions were moved to Chester, Uriconium became the tribal capital of the Cornovii. Two successive defensive systems of the city have been found, of which the earlier, dating from about the end of the first century of our era, enclosed a much smaller area than the later. This latter dates from the middle of the second century, and encloses about 170 acres. It marks the largest expansion of the town. The structure known as the Baths Building, which was excavated in 1859, was re-examined. It was found that originally it had not been intended for use as baths, but had consisted of two ranges of large rooms on either side of an enclosed courtyard, with a long two-sided hall beside it. This was built about A.D. 140 and must have formed part of the public buildings, possibly the law courts, of the town. The Forum opposite was nearly contemporary. Not very much later the whole was transformed into an elaborate and complicated bath of the usual Roman type. An interesting discovery was the body of an infant which had been placed below the floor at the time of the alteration, possibly as a foundation burial. At the end of the third century the building was destroyed by fire, but was restored in a partial and slipshod manner. It remained in use for a further hundred years.

Archæological Exploration in the Panjab

ALTHOUGH a considerable period of time has elapsed since the Government of India, soon after the discovery of Mohenjodaro and Harappa, decided to allow duly accredited archæological expeditions from outside India to explore Indian archæological sites, little advantage, unfortunately, has been taken of the opportunity. Two American expeditions and one Belgian have visited India, of which the American expedition to the Salt Hills under Dr. H. de Terra, in a series of investigations extending over several years, has produced much valuable palæontological and archæological material. The excavations at Mohenjodaro for the Archæological Survey were conducted by Dr. E. Mackay, who has since been in charge of further investigations in the Indus valley; but although Dr. Mackay may be regarded as a British excavator, no British expedition has been sent out. This neglect of opportunity is the more to be deplored in view of the evident importance of India for understanding of early cultural development in the Near and Middle East. India itself is now to make an effort to repair this neglect by the inauguration of a "Panjab Exploration Fund", on behalf of which an appeal is issued by Diwan Chaman Lall, president; Prof. E. Dickinson, acting president; and Dr. C. L. Fabri, field director. Funds have been collected in India to begin excavation in the coming autumn on the ancient city site of Surkanwali Ali, near Bhera on the Jhelum, where trial excavations have been made recently by the field director of the Fund. These have revealed the existence of at least five superimposed cities, dating from the Moghul period to pre-Buddhist times. The Fund has the support of the principal scholars and notabilities of the Panjab. A considerable sum is required to place the Fund on a permanent basis; and if a sufficient amount can be raised, it is proposed also to found an ethnographical and archæological museum, for which nucleus collections are already in hand. Contributions should be addressed to the "Panjab Exploration Fund", Imperial Bank, Lahore, or to the London Branch of the Bank, 25 Old Broad Street, London, E.C.2.

Prehistoric Mines in East Africa

EXPLORATION of a cave in the Njoro Forest Reserve of Kenya by Dr. L. S. B. and Mrs. Leakey has brought to light cultural evidence, which they believe, it is stated by the Nairobi correspondent of *The Times* (May 23), points to a connexion with prehistoric opal mining on an extensive scale. The excavations have shown that this cave was used as a place for the disposal of the dead of stone age man. The bodies were brought to the cave, placed in a shallow excavation, and burnt to ashes by a fire lit over them. As time went on, the earlier ashes were disturbed by later incinerations, and the remains of at least sixty bodies have been discovered. The large number of cultural objects found include five hundred stone and one thousand bone beads. The stone beads are especially interesting, as among them are specimens of what appear to be jade and opal, as well as rock crystal and green quartz. Attractive jade pendants were also found. Many of the beads are said to show skilful workmanship, and it is therefore suggested that they may have been brought to East Africa by traders from Egypt and Mesopotamia. The beads are being submitted to experts in England for examination and report. It has been possible to reconstruct from charred fragments both basket work and rope work, and an exquisitely carved wooden vessel. Dr. Leakey, it is stated,

attributes the large number of beads found here to trading activities attracted by the opal mines, and, tentatively, suggests 4000 B.C. as a possible date.

Plastics and the Glass Industry

IN his address to the Fifth Glass Convention held last week at Droitwich under the presidency of Mr. H. S. Williams-Thomas, Dr. V. E. Yarsley stressed the view that plastics are not to be regarded as substitutes for the older materials, glass, wood and metals. Much of the work done on the new transparent plastic materials such as the methacrylate and polystyrol products has been inspired by glass. In aircraft construction, where low weight must combine with security and good optical properties over a wide range of temperature conditions, 'organic glass' has no rival. The technique of the manipulation of these materials has progressed very considerably, but, as was brought out in discussion afterwards, not sufficiently to enable a bottle, for example, to be blown from a plastic mass in the manner in which molten glass is manipulated by fully automatic machinery. Much interest was aroused by the reference by Dr. A. Caress to the optical and other properties of materials of the 'Perspex' type, and Drs. W. M. Hampton and J. C. Peddle pointed out the tremendous range of optical properties furnished by the optical glass manufacturers to comply with the requirements of the instrument makers, and the need for both homogeneity and very precise annealing. It appears that as yet the only serious competition that might be feared in this field is in the manufacture of ophthalmic lenses, and mass-produced lenses of the type used in very cheap cameras.

"Frustration of Science" Exhibition

THE Scientists' Section of the Left Book Club held an exhibition on May 17–22 at the Unity Theatre, Goldington Street, N.W.1, illustrating "The Frustration of Science". Charts, pictures and select quotations illustrated the contrast between science as a constructive force in society and science as a weapon of destruction, science as a means towards arousing and satisfying communal needs and science merely as an instrument for profit. Side by side with evidence of the increasing concentration on productivity from the soil was shown the destruction of commodities and foodstuffs. Alongside the figures showing the multiplication of productivity was widespread evidence of malnutrition and scarcity. The meagre sum spent on health research was contrasted with that devoted to investigations in chemical warfare; and the repression of scientific work and the destruction of scientific opportunity in Fascist countries were pointedly illustrated. Comparative graphs showed the speed-up in production that follows from rationalization, and the lag that exists between this and the index of wage rates. In the advertising of fictitious remedies for all kinds of diseases, approximately £3,000,000 per annum is spent, as compared with £139,000 per annum expended from Government sources on medical research in Great Britain. A total retail turn-over of these remedies amounts to £20,000,000 per annum.

The exhibition was opened by Prof. P. M. S. Blackett, who dealt with the historical factors that called science into being, and underlined how these same forces were now frustrating it. In discussing the treatment of scientific men in Fascist countries, he stressed its blindly reactionary character, its penalization of scientific workers in the first instance and, in the drive towards war, how later it had become essential to reverse that policy, in order to regain military and aerial efficiency. It was not, he considered, the task of men of science to solve these problems by their action alone, any more than they had alone called this situation into being; but it was their duty to discard their scientific aloofness and to bring their special knowledge and understanding to bear on these social issues in order to show, in terms of social forces, how the present situation had arisen, and so to discover a way out.

Trans-Atlantic Steam Navigation

IN connexion with the recent commemoration of the centenary of the inauguration in 1838 of trans-Atlantic steam navigation, an article on which appeared in our issue of March 26, p. 540, Mr. J. W. Morgan, of Springfield, Ohio, has directed our attention to the voyage from Nova Scotia to England in 1833 by the Canadian-built steam vessel *Royal William*. The performance of this vessel led the Canadian Government in 1895 to place a commemorative tablet on the walls of the Parliament Buildings in Ottawa, on which she is referred to as "The First Vessel to Cross the Atlantic by Steam Power . . . The Pioneer of Those Mighty Fleets of Ocean Steamers by which Passengers and Merchandise of all Nations are now Conveyed on Every Sea throughout the World". The *Royal William*, of about 800 tons and 200 horse-power, left Pictou on August 17, 1833, and arrived off Cowes, Isle of Wight, nineteen days later. It has sometimes been stated that she crossed under steam power alone, but that statement cannot be substantiated. As Engr.-Capt. Smith was careful to point out in his lecture at the Science Museum on March 16, every steamship both before, and long after 1838, was fitted with sails and made the fullest possible use of the wind. Indeed it is quite impossible to say with certainty what vessel first crossed the Atlantic by steam power alone. The Atlantic had been crossed by the steamers *Rising Star*, *Curaçao* and *Savannah* before the *Royal William* made the passage, but their voyages, like hers, had nothing to do with a considered scheme for a regular service. The true significance of the events of 1838, the year which saw the Atlantic crossed and recrossed by the *Sirius*, *Great Western*, *Royal William II* and *Liverpool*, lies in the fact that they were the first vessels placed on the run with the idea of maintaining regular communication between Great Britain and the United States by steam in all weathers and at all times of the year. Of the four ships, it was the *Great Western* which unmistakably demonstrated the feasibility of the project. She was the true forerunner of our modern Atlantic liners.

Farming in the U.S.S.R.

FARMING in Soviet Russia is the title of a recent interesting article by Sir John Russell (*J. Min. Agric.*, 44, 1063). The natural conditions of this vast territory vary from arctic to sub-tropical, and the agricultural products are in consequence correspondingly wide, ranging from rye, flax and potatoes in the north, through wheat, sunflower and sugar beet in the temperate zones, to oranges and tea in the sub-tropical regions. The preponderance of grain cultivation and the small production of animal products is the chief general feature of Russian agriculture, a characteristic shared by other non-tropical continental regions such as Canada, but the distinguishing mark of the Russian system is that it is planned by a central authority, and the production of certain quantities of the various products are allocated in turn to the constituent republics, regions and collective farms by their appropriate managements. There are two types of farm, namely, the State and the collective farm. The former are managed by State officials, and the employees receive a definite wage in money. The collective farm, on the other hand, is a new departure in agricultural organization. The entire land, live stock and implements are pooled and the whole is worked as a single unit under a committee of management. Workers are allotted certain duties and their achievement is reckoned in terms of 'labour days', a standard day's labour of ploughing or milking, for example, being assessed by the committee. After the Government's claim on the produce has been fulfilled, the remainder is divided between the workers on a basis of their 'labour days', that is, their wages are in kind only. Some 98 per cent of the sown area is now in collective farms, and the peasants appear more contented than previously, so quite apart from political and social issues, the progress of this new system will be closely followed by all interested in agriculture.

Fuels for Heating and Hot-water Supply

MR. H. L. PIRIE, in a paper presented at a joint meeting of the Institute of Fuel and the Institute of Heating and Ventilating Engineers on December 1, discussed the suitability of British coal and its derivatives for heating and hot-water supply. Selection of fuel must be dependent entirely on the purpose in view, available supplies and apparatus. Gas and electricity may be regarded as coal derivatives and present certain advantages over both coal and coke for specific requirements. Nevertheless, fuel and appliances must be considered together if efficient performance is expected. Open fires, continuously burning stoves, hot-water boilers, central heating boilers and steam boilers all require special types of fuel. Mr. I. Lubbock, at the same meeting, assessed the advantages of fuel oil for heating and hot-water supply. Summarily these are: comparatively small space occupied by plant and fuel, rapid and easy filling of storage tanks, which, by suitable piping may serve two or more widely separated boiler houses, cleanliness, lack of smoke, flexibility of supply to meet the needs of varying atmospheric conditions, elimination of standby losses, automatic control, and thermal efficiency. Admittedly, gas and electricity may possess in many cases similar advantages, but they should all be taken into account in fuel selection. Fuel oil is moreover suitable for widely different types of installation. For example, it is now extensively used in office buildings, cinemas and theatres, churches, factories, hotels, trains, garages, flats, and houses, and the types of boiler which it is possible to install in these places are of necessity highly divergent. It is not claimed that fuel oil is better in every case than any other fuel, but it is claimed that oil as a fuel for central heating and hot water should be considered on its own merits in relation to other fuels.

Archæology in the University of London

CHANGES of no little importance for archæological studies are announced in the examination arrangements of the University of London. In and after 1939 no examination for the degree of B.A. in honours in archæology will be held; but archæological subjects will be added as optional or special subjects in the B.A. honours examination in classics, Greek, Latin, Arabic, Chinese, Hebrew, Indo-Aryan, Persian and history. Further, the subject of "Prehistory of Western Europe" is added to the list of subjects which may be taken at the B.A. (General) examination. In view of the very marked progress and development in method of prehistoric studies relating to western Europe in recent years the inclusion of this subject in the general arts curriculum is especially noteworthy, marking an advance in status among academic studies. Similarly at Oxford, by a decree of Congregation, geography and anthropology jointly have been elevated to the dignity of a 'faculty'.

University of London: Progress since 1900

IN his report on the work of the University during the year 1937–38, Dr. H. L. Eason, the recently appointed principal, briefly reviews the progress that it has made since it became a teaching university in 1900 (University of London. Report of the Principal on the Work of the University during the Year 1937–38. Pp. 13. London: University of London). The number of candidates for examination increased sevenfold to 46,000, their fees tenfold to £188,000, the expenditure of the University, exclusive of grants dispensed to schools, institutions and departmental institutes, tenfold to £247,000. There are now in the schools and institutions of the University 240 professors, 160 readers and 945 recognized teachers; the roll of internal students reading for degrees and diplomas comprises 13,730 names, whilst the registered external students number 10,771. Of the 4,863 candidates for degrees in 1937, 3,074 were internal and 1,789 external. The principal recalls words used by Lord Haldane in 1920: "It ought to be the chief centre of learning in the entire Empire, . . . Here ought to be concentrated the highest talent, the highest level in that passion for excellence of which I have spoken, the highest atmosphere, such as only can come in a great capital at the heart of a great country." More and more, says the Principal, does the University approach this ideal. Among the

notable events of the past session was the inauguration of a Research Fund to which the University Court resolved to appropriate not more than £5,000 a year, from which grants are to be made for specific projects for research.

Research in Tropical Medicine

THE Medical Research Council is offering up to three junior fellowships immediately, for award to qualified medical men wishing to receive training with a view to careers in research work in tropical medicine. The fellowships will be tenable for three years. The first year will be spent at a school of tropical medicine; the second in doing research in the same or some other institution at home; and the third largely in work under direction at some centre in the tropics. The stipend will be at the rates of £300, £400 and £500 per annum in the successive years, with an additional allowance during service abroad and necessary expenses. In three years' time, at least one senior fellowship will be available for candidates who have held the junior fellowships. This will be awarded for a further period of three years, carrying stipend at the rate of £600–£750 per annum, with an additional allowance during service abroad and expenses. The time will be spent mainly in research work in the tropics. The Council is also prepared to consider immediate applications for senior fellowships from candidates who have had adequate experience in research work, whether already specially trained in tropical medicine or not. The Council further intends to establish in due course, as suitable investigators become available as the result of the fellowship scheme, permanent and pensionable appointments for research work in tropical medicine, including senior posts. Further information can be obtained from the Secretary, Tropical Medical Research Committee, 38 Old Queen Street, London, S.W.1.

Rich Display of the Aquarids

MOHAMMED A. R. KHAN, Begumpet, Deccan, carried out observations of the η Aquarids on May 1–5, the total time of observation being $3^h\ 45^m$. During this period he saw 37 Aquarids and 32 sporadic meteors. The Aquarids are described as moving with long, white, evanescent trains, and the maximum display took place on May 2. In 1935 the maximum occurred on May 5 and was not so rich as this year. An interesting and important note is added by the observer. In some cases, not only with the Aquarids, but also with the sporadic meteors, the meteors grew considerably brighter towards the end of their course. One Aquarid, starting with a scarcely visible nucleus, developed a long voluminous train, glowing with a beautiful apple-green luminescence, towards the end of its flight. A sporadic meteor which was moving rather slowly developed a bright coma of reddish-green colour, attaining a magnitude 3 at maximum. These facts are important in connexion with a photograph of a meteor shown by Mr. E. H. Collinson at the meeting of the British Astronomical Association on March 30. It was suggested by some members that the bright portion of the photograph was the beginning of the path, but those who were experienced in meteor work did not corroborate this view. The observations from Begumpet confirm the usually accepted fact—that meteors generally brighten up towards the end of their flight.

The Night Sky in June

THE summer solstice on June 22 brings the shortest night lasting, in the northern latitude of Greenwich, less than 7½ hours, according to the sun's setting and rising, and a little more than 3 hours if twilight (nautical) be taken into account. The moon is full on June $12^d\ 23{\cdot}8^h$ and new on June $27^d\ 21{\cdot}2^h$ U.T. A lunar conjunction takes place with Jupiter on June $19^d\ 3^h$: with Saturn on June $22^d\ 15^h$ and with Venus on June $30^d\ 14^h$. Venus, a bright star in the evening western sky, sets at about $22\frac{1}{2}^h$, preceded by Mars. Jupiter rises before 0^h after June 10; its present stellar magnitude is about −2·1, as compared with −3·4 for Venus. Saturn is reappearing in the skies as a morning star, and in the middle of the month rises after 1^h. About 21^h in mid-June, Arcturus stands out conspicuously on the southern meridian. Lower in the south at this time will be found Spica just west of the meridian and Antares on the east. Antares, with a radius 450 times that of the sun's, has an average mean density of only 1/3,000 that of air at N.T.P. From a radiant not far from Antares come the slow-moving fireballs known as Scorpiids. Two interesting double stars in Bootes may be noted—ε Bootis, having the euphonious name of *Pulcherrima*, is a beautiful double the components of which, separated by 2¼″, are a 3rd magnitude yellow star and a blue star of magnitude 6½. ξ Bootis, with a period of about 160 years and an orbit of great eccentricity, comprises a yellow star (mag. 4·7) and a purple star (mag. 6·6) separated by about 4½″. α Herculis provides another finely coloured pair—a mag. 3·0 orange star and a blue green mag. 6·1 also separated by 4½″. Between η and ζ Herculis may be seen a nebulous spot of light which is the well-known globular cluster in Hercules. The stellar population of this spherical system is not less than 50,000 stars; these occupy a volume of space (500 light years across) which would be able to contain the greater number of our naked-eye stars.

Announcements

THE degree of doctor *honoris causa* has been conferred by the University of Athens on Sir James Frazer in recognition of his distinguished contributions to Greek classical learning.

SIR FREDERICK HOBDAY, formerly principal and dean of the Royal Veterinary College, will give a course of six lectures entitled "A Comparison of Diseases in Animals and Men" at St. George's Hospital Medical School, London, at 5 p.m. on Mondays from May 30. They will be open to medical and veterinary practitioners and students without fee.

THE following Royal Society lectures have recently been announced: June 16, Bakerian Lecture by Prof. C. K. Ingold, professor of chemistry in the University of London, on "The Structure of Benzene"; June 30, Croonian Lecture by Prof. A. N.

Richards, professor of pharmacology in the University of Pennsylvania, on "Processes of Urine Formation"; November 10, Ferrier Lecture by Prof. E. D. Adrian, Foulerton research professor, on "Some Problems of Localisation in the Central Nervous System"; December 8, Pilgrim Trust Lecture by Dr. I. Langmuir, associate director of the General Electric Co., New York, on "Molecular Films". All lectures will commence at 4.30 p.m.

AT the anniversary meeting of the Linnean Society held on May 24, the following officers were elected for the year 1938–39: *President*, Dr. J. Ramsbottom; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. M. A. C. Hinton (zoology) and Mr. I. H. Burkill (botany); *New Members of Council*, Prof. W. A. F. Balfour-Browne, Mr. R. H. Burne, Dr. G. R. de Beer, Dr. E. Marion Delf, Dr. Anna B. Hastings.

THE following have been elected to fill the vacancies on the board of the Institute of Physics which will occur on September 30: *President*, Dr. C. C. Paterson; *vice-president*, T. Smith; *honorary treasurer*, Major C. E. S. Phillips; *honorary secretary*, Prof. J. A. Crowther; *ordinary members of the board*, Dr. J. D. Cockcroft and E. B. Wedmore.

THE National Fitness Council for England and Wales (1 Queen Anne's Gate Buildings, Dartmouth Street, S.W.1) has set up a Medical Committee with the following terms of reference: (1) To take such action as may be found desirable in order to enlist the co-operation of the medical profession in promoting the policy of the Council; and (ii) To consider and report on the medical aspect of the Council's work. The chairman of the Committee is Lord Dawson of Penn, and the vice-chairman Sir Kaye le Fleming.

THE Minister of Finance of Northern Ireland has announced that the Government proposes to increase the annual grant to Queen's University, Belfast, by £20,000. The University receives at present from this source £40,000 annually for general purposes, and £7,000 for the Faculty of Agriculture. The Government also proposes to make a grant of £2,500 a year to Magee University College, Londonderry, which is affiliated to the University of Dublin, and to increase the annual grant to Armagh Observatory from £100 to £300, and to make to the observatory a special grant of £150 this year.

A LARGE earthquake was recorded at Kew Observatory on May 23. The first movement arrived at Kew at 7h. 31m. 11s. G.M.T. and the record indicates that the shock originated 5,900 miles away in Japan at 4.19 p.m. local time. The largest movements of the ground at Kew were about 1/50 of an inch.

THE tenth International Congress for Psychiatry will be held in Oxford on July 29–August 2 under the presidency of Prof. C. G. Jung of Kussnacht. Further information can be obtained from the secretary, Mr. H. Gibbs-Smith, 106 Brompton Road, London, S.W.3.

THE forty-third Annual Congress of the South-Eastern Union of Scientific Societies will be held at Worthing on June 21–25, under the presidency of Dr. Julian Huxley. The subject of Dr. Huxley's presidential address will be "Natural History—Taxonomy and General Biology". Further information can be obtained from the honorary general secretary, Mr. A. Farquharson, Le Play House, 35 Gordon Square, London, W.C.1.

THE second Conference of the International Guild of Hospital Librarians will be held in Berne on June 7–10, when the speakers will include Mrs. M. E. Roberts, Mrs. Beddington, Mrs. Raymond, Dr. Georges Duhamel of Paris, Prof. Walter Gut and Dr. Wyrsch. Further information can be obtained from the Secretary of the Guild, 48 Queen's Gardens, London, W.2.

AN institute for the study and prevention of occupational diseases has recently been established in Paris by the French Minister of Health. The institute, which is the first of its kind in France, includes an examination room, a laboratory for extensive chemical and toxicological research, a special photographic laboratory and a library of international literature dealing with occupational diseases. The organ of the institute is the *Archives des maladies professionnelles, d'hygiène et de toxicologie industrielles*, which will appear every two months. Further information can be obtained from the Secretary, Institut d'étude et de prévention des maladies professionnelles, 6 rue de la Douane, Paris X^{e}.

Under the joint auspices of the Institution of Naval Architects and of the Institute of Marine Engineers an International Conference of Naval Architects and Marine Engineers will be held in London on June 16–18. It is anticipated that some three hundred, including ladies, will attend from many parts of the world in addition to the British participation. Important delegations are expected from Belgium, France, Germany, Holland, Italy and the United States of America. Further information and a programme of papers can be obtained from the Secretary, Mr. C. V. Boys, 3 Robert Street, Adelphi, London, W.C.2

A SIXTH spectroscopy conference will be held at the George Eastman Research Laboratories of the Massachusetts Institute of Technology on July 18–20, repeating the type of programme presented at the conferences held during the past five summers. Morning and afternoon meetings will be held on three days. Papers and discussions on analysis of materials by the emission spectrum, absorption spectrophotometry, photographic photometry, biological and chemical effects of spectral radiation, and industrial applications of spectroscopy, are being prepared. The usual summer courses on practical and applied spectroscopy will be offered at the Institute between June 13 and July 23. Further information can be obtained from Prof. George R. Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 978.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nitrogen and Argon in the Earth's Crust

IN a recent letter[1], it was stated that various specimens of granite contain per gram about 10^{-6} c.c. of neon and 4×10^{-5} c.c. of argon. This makes the ratio neon/argon some thirteen times as great as in the atmosphere.

The same rocks and a considerable number of others have now been examined for nitrogen. The quantity found is remarkably uniform, and amounts to about 3×10^{-3} c.c. per gram. Various evidence indicates that the nitrogen is not occluded like the argon and neon, but is for the most part held in chemical combination.

The ratio argon/nitrogen comes out about $1{\cdot}3 \times 10^{-2}$. The atmospheric ratio is about $1{\cdot}2 \times 10^{-2}$, some nine times greater.

It appears from these nitrogen determinations that, contrary to what has been supposed, the total nitrogen in the earth is many times more than in the atmosphere. It has been estimated[2] that 0·65 of the earth's mass consists of rock. On this basis, it may be calculated that the rocks contain thirty-seven times as much nitrogen as the atmosphere.

Discussion of the cosmological bearing of these results is deferred.

RAYLEIGH.

69 Cadogan Square,
London, S.W.1.
May 12.

[1] NATURE, **141**, 410 (March 5, 1938).
[2] See, for example, Russell, H. N., "The Solar System and Its Origin" (New York: The Macmillan Co., 1935), p. 56.

Absorption Bands and Electron Transitions in Coloured Fluorites

THE absorption spectra of fluorites coloured by natural or artificial irradiation show, in general, principally two regions of strong absorption[1]: from 350 to 470 mμ and from 530 to 650 mμ. The latter has already been attributed to reduced calcium, either as isolated atoms or as colloidal particles; the former can now be attributed to the bivalent ions of the rare earth elements, which, as has been shown before[2], are responsible for the diffuse fluorescence bands of fluorites. The blue Eu^{++}-band has its maximum of excitation[3] in the region of 350–390 mμ, the red band of Sm^{++} in CaF_2 most likely towards 430 mμ. The red Sm^{++}-fluorescence of some natural fluorites is connected with absorption maxima between 420 and 470 mμ. The different colours of fluorites can now be explained by the varying intensities of the different absorption maxima: Eu^{++} alone gives a light yellow colour (for example, Derbyshire), Sm^{++} a deeper yellow brown (Wölsendorf and others), the bivalent rare earths together with the Ca-maxima give the green colours (Weardale), predominance of the Ca-maxima the blue and violet colours, violet corresponding to a more disturbed lattice (larger colloidal particles ?).

Various colour changes through heat or light can be attributed to the transfer of electrons from the bivalent rare earth ions to the calcium ions and back, for example, the 'improving' of the colour of greenish fluorites by exposure to sunlight[4], which gives deeper purple colours: reduction of calcium by electrons given off photo-electrically by the bivalent rare earths. In some yellow and green fluorites, this transfer is reversible at low temperatures[5]: irradiation with ultra-violet light in the rare earth maximum diminishes this and builds up the calcium maximum (violet colour); irradiation in this maximum by yellow light reproduces the original colour. This return is accompanied by luminescence and one can, in this case, regard the 'excited' state of fluorite as due to the transfer of electrons from the bivalent rare earths to the calcium, that is, to a chemically different constituent.

Another example of this electron transfer is perhaps given by certain fluorites that fluoresce red (Sm^{++}) in their natural state. This red fluorescence is sometimes increased by heating the sample[6], the electrons returning from the Ca-atoms to the Sm^{+++}-ions and reducing them to Sm^{++}, an effect that can also be obtained by artificial radium treatment.

If circumstances allow, a more detailed account will be given elsewhere.

K. PRZIBRAM.

Vienna.
April 5.

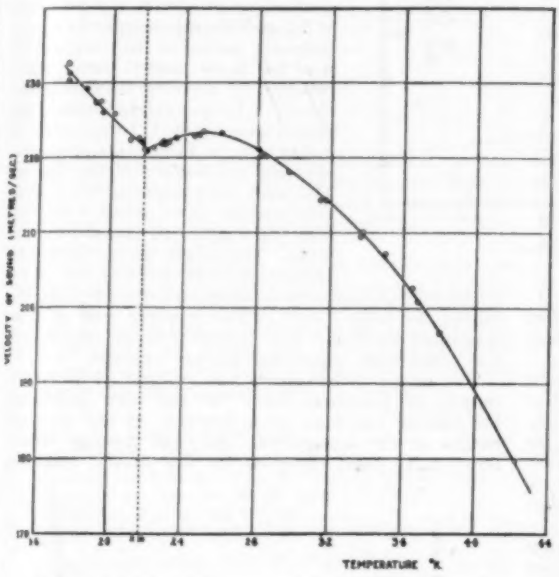
[1] Yoshimura, J., *Sci. Pap. Inst. Phys. Chem. Res.*, **20**, 170 (1933) Mollwo, E., *Götting. Nachr.*, N.F., **1**, 79 (1934); Eysank, E., *Wien. Ber.*, IIa, **145**, 387 (1936); and unpublished results by M. Belar.
[2] Przibram, K., NATURE, **139**, 329 (1937); and the summary in *Z. Phys.*, **103**, 331 (1936); **107**, 709 (1937).
[3] de Groot, W., *Arch. Neerland.*, IIIa, **7**, 207 (1924); and unpublished results by Eckstein, H. Ph. For the colour and absorption of the pure salts and solutions of the bivalent rare earths, see McCoy, H. N., *J. Amer. Chem. Soc.*, **58**, 1577 (1936); Butement, F. D. S., and Terry, H., *J. Chem. Soc.*, 1112 (1937); Ephraim, F., Jantsch, G., and Zapata, Cl., *Helv. chim. Acta*, **16**, 261 (1933).
[4] Sweet, J. M., *Mineralog. Mag.*, **22**, 257 (1930).
[5] Przibram, K., and Haberlandt, H., *Wien. Anz.*, (Dec. 6, 1934); Kellermann, E. W., *Wien. Ber.*, IIa, **146**, 115 (1937).
[6] Haberlandt, H., *Wien. Ber.*, IIa, **146**, 1 (1937).

Velocity of Sound in Liquid Helium

THE velocity of sound in helium I and helium II has been determined by a method similar to that used by Pitt and Jackson[1]. Standing waves were set up in the liquid between a vibrating quartz crystal and a brass reflecting plate. The crystal was driven near its natural resonance, at a frequency of 1,338 kilocycles per second, maintained constant by means of a quartz crystal master oscillator. The reflector was moved by means of a micrometer screw, and as it passed through the nodal positions, the existence of the standing waves was shown by the resonant reaction on the vibrating crystal. Sharp and easily measurable resonance peaks were obtained

in both helium I and helium II, the wave-length being of the order of 0·16 mm. The temperature was controlled by means of the helium vapour pressure.

The accompanying graph shows the results, velocity in metres per second plotted against temperature in °K. The points marked by solid circles are considered less reliable than the open circles. For the remainder, the probable error is estimated to vary from about 0·1 per cent in helium I to about 0·25 per cent at the lower temperatures in helium II.



CURVE SHOWING RELATION BETWEEN TEMPERATURE OF LIQUID HELIUM AND THE VELOCITY OF SOUND IN IT.

The velocity at points not too close to the λ-point agrees approximately with the values calculated from the adiabatic elasticities estimated with the aid of the entropy relations[3]. It is doubtful whether the expected discontinuity in velocity at the λ-point occurs or not, and it is certainly less than 0·5 per cent. The change in elasticity calculated from Ehrenfest's relations for a phase change of the second order[3] would cause a decrease in the velocity from helium I to helium II of about 2·5 per cent. Other than this disagreement, there is no reason to suppose that the ordinary formula for the velocity of sound is not obeyed in both helium I and helium II, and it is hoped that the results may be used to adjust the entropy relations for liquid helium.

Profs. Grayson Smith, J. O. Wilhelm, A. Pitt and Mr. J. C. Findlay have co-operated in this work.

E. F. BURTON.
(Director).

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April 26.

Absorption of Group *A* Neutrons in Silver

IN examining the details of the silver resonance level for Group *A* neutrons, it becomes important to know the self-absorption coefficient for very thin absorbers and detectors. This information is, for example, useful in the interpretation of experiments on the Doppler broadening of this level[1].

In their early survey of slow neutron effects, Amaldi and Fermi[2] found, with a detector of 0·057 gm./cm.², an average absorption coefficient of 20 cm.²/gm. for group *A* neutrons in silver. Since the influence of self-reversal[3,4] should be important for a detector of this thickness, it was thought worth while to determine again the self-absorption curve for these neutrons with a thinner detector (0·011 gm./cm.²), and with reasonably good geometry.

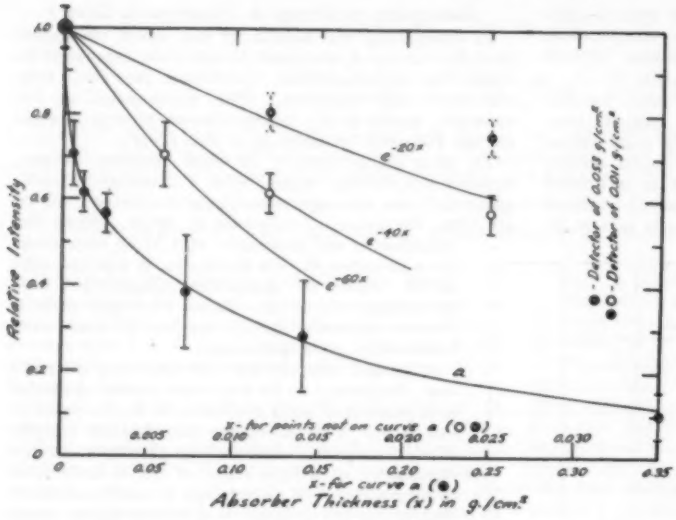
A hinged support allowed six silver foils (15 mm. diameter) to be activated simultaneously, and permitted their activities to be followed at one time with a single thin-walled Geiger-Müller counter. Collimating channels, in the equivalent of 0·7 gm./cm.² of boron lined with 0·35 gm./cm.² of silver, led to each detector, restricting the inclination of activating neutrons to 30° or less. Frisch[4] showed that in permitting such an angle of approach one would introduce an error independent of absorber thickness which would give activities corresponding to absorbers 7 per cent thicker than actually used.

The source of slow neutrons was 300–800 mc. of radon plus beryllium imbedded in paraffin. A cadmium filter of 0·83 gm./cm.² was used to eliminate thermal neutrons. Scattering materials in the neighbourhood of the detectors were carefully avoided. The detectors were irradiated for 45 seconds, and measurements of one minute duration were begun 15 seconds later. All results were corrected for the presence of the 2·3 minute period and for the contribution of Group *B* neutrons.

The accompanying figure [see over] shows the final absorption curve for detectors of 0·0114 gm./cm.² (Curve *a*), and, on a thickness scale ten times larger, the initial part of the same curve and corresponding points for detectors of 0·053 gm./cm.².

The absorption coefficient (20 cm.²/gm.) for the thicker detectors agrees with the value of Amaldi and Fermi[2]. The points for zero and 0·0058 gm./cm.² absorption, with thin detectors, give, however, an absorption coefficient of 59 ± 19 cm.²/gm. This value represents a minimum, because even for the thin detector, self-reversal would be expected to make the absorption coefficient lower (possibly 25 per cent) than the true initial absorption coefficient. Also, the rather uncertain correction for the influence of Group *B* neutrons was made in such a way as to give the absorption coefficient too low a value. A minimum value for the contribution of this group was estimated by correcting to the amount of Group *A* to be expected with the thickest absorber used assuming resonance form for the line (Doppler broadening was neglected, making the value for the Group *A* component a maximum). As the self-absorption coefficient for Group *B* is unknown, the same correction was taken for all absorber thicknesses. The boron-silver shield for Group *A* was comparatively transparent for the less absorbable group; so the Group *B* correction was 50 per cent

[1] Pitt, A., and Jackson, W. J., *Can. J. Research*, **12**, 686 (1935).
[2] Keesom, W. H., and Keesom, Miss A. P., *Physica*, **1**, 128 and 161 (1933). *Leiden Comm.*, Supp. No. 76 and earlier papers.
[3] Ehrenfest, P., *Kon. Akad. Wetenschappen*, **36**, 153 (1933). *Leiden Comm.*, Supp. No. 75.



as large as the initial intensity attributed to Group *A*. It is estimated that the error introduced by this correction would tend to make the apparent initial absorption coefficient 10–15 per cent too low.

Considering that only one of the two equally abundant silver isotopes should be effective in the resonance absorption of Group *A* neutrons, the absorption coefficient indicated above should be doubled, giving 120 cm.²/gm. This value, which represents by far the largest resonance cross-section measured to this time, cannot be used with activation values of Amaldi and Fermi[2,5,6] to determine the total width of the line because it leads to the following contradiction: the combined natural and Doppler width so determined is smaller than the Doppler width alone obtained directly from the energy of the line and the mass of the silver atom.

A discussion of this measurement as related to the Doppler effect[1] will appear in the *Journal de Physique*.

HUGH PAXTON.

Laboratoire de Chimie Nucléaire,
Collège de France,
Paris.
April 9.

[1] v. Halban and Paxton, NATURE, **141**, 116 (1938).
[2] Amaldi and Fermi, *Phys. Rev.*, **50**, 899 (1936).
[3] v. Halban and Preiswerk, *J. Phys.*, **8**, 29 (1937).
[4] Frisch, *Kgl. Danske Vid. Selsk.*, **14**, 12 (1937).
[5] Bethe and Placzek, *Phys. Rev.*, **51**, 450 (1937).
[6] Bethe, *Rev. Mod. Phys.*, **9**, 69 (1937).

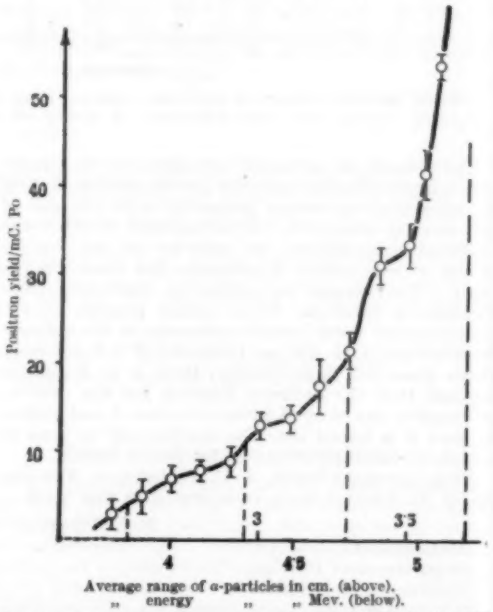
Fine Structure of the Yield-Curve of the Transmutation of Aluminium

THE yield-curve of the transmutation $^{27}Al(\alpha; {}^{1}n)^{30}P$ is of theoretical importance in relation to that of the transmutation $^{27}Al(\alpha; {}^{1}H)^{30}Si$. Four very definite resonance levels have been observed for the proton emission[1,2] with α-particles of ranges 2·5–4·0 cm. In spite of this, one very broad, or some less definite levels have been observed for the neutron emission[3,4]; the yield-curves of the two transmutations seemed to be different.

Since the yield of the neutron emission is much smaller than the proton yield at these ranges, a larger solid angle of the α-particle beam was favoured by recent investigators on account of the uniformity of the ranges. It would be essential to bombard with α-particles of uniform range to resolve the levels.

In the present work, a target consisting of an aluminium hemisphere of 50 mm. diameter was bombarded from a polonium source of 3 mm. diameter at its centre[5] (strength about 10 mC.). This arrangement enabled us to obtain a solid angle of 2π, and the inhomogeneity due to different paths of the α-particles was not more than 1 mm., when retarded by a carbon dioxide atmosphere of 10 mm. air equivalent. An inhomogeneity of ± 1 mm. arose in a gold layer of 1 mm. air equivalent, covering the surface of the source. The large solid angle of the activation enabled us to obtain a reasonable yield although the source was weak. The target was activated to saturation of ^{30}P and was put over a counter which consisted of a hemisphere of aluminium (about 50 mgm./cm.²). The counter had a loop (platinum wire) of 3 mm. diameter in the centre and was filled with argon and alcohol vapour[6].

The graph below shows the integral yield (thick target) of positrons from ^{30}P per mC. polonium for infinite exposure as a function of the average ranges of the α-particles. At each α-range where levels have been observed for the proton emission



THE YIELD-CURVE OF THE TRANSFORMATION $^{27}AL(\alpha; {}^{1}n)^{30}P$. NUMBER OF POSITRONS FROM ^{30}P PER MC. POLONIUM (THICK TARGET, INFINITE EXPOSURE) AS A FUNCTION OF THE ENERGY OF THE EXCITING α-PARTICLES. DOTTED VERTICAL LINES DENOTE RESONANCE LEVELS FOR THE PROTON EMISSION.

(dotted vertical lines at 2·55 cm., 2·95 cm., 3·3 cm. and 3·75 cm. average ranges), resonance levels exist for the neutron emission. The first process, the capture of the α-particle, is independent of the emitted particle (proton or neutron). There is a difference in the yield of the levels. All four levels give about the same yield for the proton emission ($3{\cdot}5 \times 10^{-7}$)[1]. A tentative determination of the yield of the neutron emission gives the following values, supposing that about 30 per cent of the positrons entered the counter :

Average range	^1_0n yield	$\frac{^1_1H \text{ yield}}{^1_0n \text{ yield}}$
2·55	$0{\cdot}5 \times 10^{-6}$	70
2·95	$0{\cdot}5 \times 10^{-6}$	70
3·3	$1{\cdot}5 \times 10^{-6}$	23
3·75	$3{\cdot}5 \times 10^{-6}$	10

It is interesting that the branching ratio, proton yield/neutron yield, decreases with increasing energy of the exciting α-particle. Differences in the change of energy at the two transformations give a very obvious explanation for this fact.

The apparatus has been built in the Institute of Physics, Debrecen, Hungary, by means of a financial grant from the Academy of Sciences, Budapest. I wish to thank Prof. Z. Gyulai for his kind interest, and also Prof. St. Meyer and Prof. G. Stetter for their valuable suggestions and for having allowed me to carry out the measurements in Vienna.

A. SZALAY.

Institut für Radiumforschung,
Vienna. Feb. 16.

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Measurement of the Anærobic Glycolysis of the Regions of the Amphibian Gastrula by the Cartesian Diver Ultramicromanometer

THE use of the Cartesian diver as an extremely sensitive micromanometer was suggested in this journal last July by Linderstrøm-Lang[1], and the description of the technique was somewhat amplified in a subsequent note[2]. Since adequate micro-methods are, for the embryologist, indispensable, we have employed ourselves since that time in the adaptation of the method for use with small pieces of tissue, and in particular with the regions of the amphibian gastrula dissected out by the Spemann glass needle technique.

The delicacy of the method in its present form may be gauged by the fact that whereas 1 cm. on the scale of the usual Warburg manometer corresponds to a gas change of about 20 c.mm., 1 cm. on the scale of the diver manometer corresponds to a gas change of 0·008 c.mm.

For our purpose, a number of special problems required solution. (1) Fragile embryonic tissue cannot be passed through an air-water interface, and the divers must therefore be submerged beside the tissue fragments in the medium to be used. In our experiments the medium used was Holtfreter solution containing an amount of bicarbonate sufficient to bring it into equilibrium with 5 per cent carbon dioxide in nitrogen. After the fragments have been pushed into the diver bulbs, a known amount of Holtfreter-bicarbonate solution is withdrawn from the divers. (2) Completely anærobic conditions within the divers are attained by handling them inside a special glass chamber with one or more pipettes mounted on glass universal joints. A stream of the nitrogen–carbon dioxide mixture passes through the chamber and the pipette. (3) As pieces of tissue of the order of 100 γ dry weight are used, a new Kjeldahl technique was devised for measuring the amount of total nitrogen present. The incineration vessels are so shaped that they may afterwards function as diffusion vessels analogous to those of the well-known Conway method. (4) Since total nitrogen was estimated, the ammonium sulphate proposed by Linderstrøm-Lang as the flotation fluid for the divers was replaced by lithium chloride at the same density, which has the further advantage of considerably lower gas solubility. (5) Since developing amphibian embryo tissue, unlike that of adult mammals, forms considerable quantities of ammonia, estimations of ammonia produced during the experimental period were necessary ; these were done following the method of Linderstrøm-Lang and Holter[3]. (6) The method of calibration of the divers was further investigated. A suitably modified Warburg equation was verified for divers of various volumes by direct comparison with Warburg manometers of the usual pattern, using reactions such as the decomposition of oxaloacetic acid and the autoxidation of cystein*. All these adaptations and special procedures will be fully described in forthcoming publications.

The importance of an understanding of the metabolism of the gastrula lies in the fact that the vertebrate axiation of normal development depends on the liberation of a chemical substance or substances at the dorsal lip of the blastopore and not elsewhere. It is known that glycogen disappears from the invaginating material[4], and there is evidence that glycogen may form part of the inactive organizer complex[5]. We now found, by an extensive set of measurements on the embryos of *Rana temporaria*, a substantial difference between the metabolism of the dorsal lip of the blastopore and that of the ventral ectoderm.

	Q^N_L*	Ammonia (c.mm./γ dry weight/5 hr.)
Dorsal lip of blastopore	0·63	2·31
Ventral ectoderm	0·21	0·97

While noting the significance of these differences, we would prefer to postpone the discussion of them until data can be obtained for Q_{O_2}, $Q^{O_2}_L$ and *R.Q.*, in the investigation of which we are now engaged.

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May 4.

* We find that although the oil seal greatly retards, it does not completely prevent, the escape of gas from the diver, but if the oil and the lithium chloride solution are previously saturated with the gas mixture, the error due to gas loss is reduced to negligible proportions.

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[4] Heatley, N. G., *Biochem. J.*, **30**, 2568 (1935).
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Ascorbigen in Plant and Animal Tissues

WE have previously given evidence[1,2] to show that cabbage contains ascorbic acid in a combined form from which ascorbic acid is released on heating. Chloroform extracts of dried cabbage, which were quite free from ascorbic acid as shown by the indophenol indicator, developed a marked dye-reducing value on heating. Treatment of cabbage with hydrogen sulphide in the hot and cold conditions also led to the same conclusion. Further, it was found by treatment with ascorbic acid oxidase, that 60–70 per cent of the indophenol reducing value of the chloroform extract of cabbage is to be attributed to combined ascorbic acid[3]. This work showed incidentally that, apart from combined ascorbic acid, which we called 'ascorbigen'[4], cabbage contains some non-specific reducing substance also in a combined form.

Biological experiments with guinea pigs confirmed the view that 60–70 per cent of the indophenol-reducing value of the dried chloroform extract of cabbage was due to ascorbigen. The guinea pigs were fed on a scorbutic diet and when they were falling in weight one group was given supplements of ascorbigen and the other group was fed with equivalent doses of ascorbic acid (varying from 2 mgm. to 4 mgm. in terms of ascorbic acid). The rates of growth in the two groups during the next ten days were comparable. Similar results have just been reported by Reedman and McHenry[5], who have given biological evidence for the presence of ascorbigen in potato. They have, however, fed the experimental guinea pigs with ascorbigen and ascorbic acid from the start of the experiment; but their results and ours are substantially in agreement. It has been possible to purify the ascorbigen of cabbage very considerably by extracting dried cabbage with chloroform, treating the dried chloroform extract with water, re-extracting with chloroform, again extracting with water and precipitating with alcohol. The substance is under further investigation.

We have observed the presence of ascorbigen and of some non-specific reducing substance in a combined form in the brain and liver tissues of the normally fed guinea pig. Similar results have also been obtained with urine by Mr. S. Bannerjee in this laboratory, which are confirmatory of the findings of Scarborough and Stewart[6]. It thus appears that the distribution of ascorbigen and some non-specific reducing substance in a combined form in plant and animal tissues is fairly general, though perhaps not universal.

In any estimation of ascorbic acid from the nutritional point of view, the foodstuff should be evaluated with reference to (1) free ascorbic acid, (2) dehydroascorbic acid, and (3) ascorbigen, as we pointed out elsewhere[7]. For this, a method has been developed involving treatment of the material with hydrogen sulphide in the hot condition, removing hydrogen sulphide in a current of carbon dioxide and treatment of an aliquot with ascorbic acid oxidase. This method appears to give the 'total' ascorbic acid of foodstuffs.

Details are being published in the *Journal of the Indian Chemical Society*.

University College of Science and Technology, Calcutta. March 29

B. C. GUHA.
P. N. SEN-GUPTA.

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[3] Guha and Sen-Gupta, *Science and Culture*, **3**, 59 (1937).
[4] Pal and Guha, *Proc. Biochem. Soc., Calcutta*, **2**, 8 (1936–37).
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Action of Anol and its Derivatives on the Nipple of the Guinea Pig

Dodds and Lawson[1] have stated that anol will induce œstrus in rats. W. Jadassohn, Uehlinger and Margot[2] have investigated whether anol will cause enlargement of the nipples of guinea pigs by simple external application of the solution of this substance (nipple test with anol). The result was positive although not so strong as with œstrone. Later, Dodds and Lawson[3] found that pure anol in not very large doses failed to induce œstrus. We reinvestigated the action of pure anol in the nipple test and found it to be completely negative. (A solution of the same anol prepared a few months later showed a positive nipple test.)

We have examined by means of the nipple test substances which may have been responsible for the activity of the 'active anol solutions', that is, derivatives of them.

The demethylation of anethol, by means of a Grignard reaction (Serini and Steinruck[4]) gave rise to an anol that contained polymerization products; this polymerized material after acetylation boiled at 180–210° under 0·5 mm. pressure. Similar experiments were also made with isoanol[5] and its acetyl derivatives prepared by heating isoanethol with potassium hydroxide in a sealed tube under pressure (N. R. Campbell, E. C. Dodds and W. Lawson[5]).

All these preparations were active in the nipple test. However, the application of œstrone solution in a concentration of 0·003 γ per c.c. gives a definite effect, whereas these preparations in a concentration of 1 γ per c.c. were quite inactive; 10 γ per c.c. was weakly active and 60 γ per c.c. showed a strong effect.

So far as the nipple test is concerned, we must refer to our previous publications[1,5,7,8]. For the present, however, we shall briefly recall its principle. We have developed a simple method of measuring the enlargement of the nipple (male guinea pig). We have found that external application of very small doses of female sex hormones produces such an enlargement. This method has proved to be specific and quantitative.

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April 29.

[1] NATURE, **139**, 627 (1937).
[2] *J. Invest. Derm.*, **1**, 32 (1938).
[3] NATURE, **139**, 1068 (1937).
[4] *Naturwiss.*, 682 (1937).
[5] NATURE, **141**, 78 (1938).
[6] *Helv. med. Acta*, **4**, 199 (1937).
[7] *Klin. Wschr.*, **9**, 313 (1937).
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'Climbing Organs' in Insects

MANY insects possess adhesive organs (pulvilli, tarsal or tibial pads, etc.) which enable them to climb on perfectly clean glass. Presumably these organs function whenever the foot comes in contact with any surface, such as leaves or polished stones or the bodies of other insects, too smooth for the claws to grip. Miller has suggested[1] that the 'fossula spongiosa' of adult Reduviids may have been

developed for the purpose of holding the bodies of their prey; Gillett and I[2] suggested that it might be of use in holding the other sex during copulation.

In unpublished observations on the bed-bug *Cimex*, we could obtain no evidence that the similarly placed organ will assist this insect in walking on glass; the 'fossula' appeared equally unsuited to this purpose in dried specimens of various Reduviids. It is only moderately efficient for this purpose in *Triatoma*[3]; but as anyone can satisfy himself in a few minutes, the adult *Rhodnius* is able to hold and climb on clean glass, even when nearly vertical, by means of this tibial organ. For that reason, it was described as a 'climbing organ'[3]. But since this type of 'climbing' is only a special case of adhesion, and since the natural purpose of such organs is not always clear, it might be preferable to refer to them simply as 'adhesive organs' without prejudice to the question of their normal function. Though very different in appearance from the homologous 'fossula spongiosa' of some other Reduviids, this highly efficient adhesive organ of *Rhodnius* is certainly not a vestigial structure.

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[1] Miller, N. C. E., NATURE, 141, 749–750 (1938).
[2] Gillett, J. D., and Wigglesworth, V. B., *Proc. Roy. Soc.*, B, 111, 365–375 (1932).

Viscosity of Monomolecular Films

Two letters by Harkins and Myers, and by Harkins and Kirkwood respectively, concerning a surface viscosimeter have recently appeared in NATURE[1]. We wish to direct attention to the previous results that we have obtained with a viscosimeter of the same type[2].

We have shown experimentally that the surface flow per second, Q, is in fact proportional to the difference of pressure and inversely proportional to the length of the channel, but we think it necessary to insist that there is no law analogous to Poiseuille's law concerning the width of the slit. The corresponding Poiseuille equation for a two-dimensional fluid should contain a factor d^3 (d = width of slit). The results of our systematic study with channels of different widths show clearly that the problem is much more complicated. There is no doubt that we have simultaneous entrainment of the water and that the viscosity of the substrate becomes the preponderant factor as soon as channel widths of the order of 1 cm. are reached, that is, the flows per unit time become independent of the nature of the fluid film as the diameter increases, finally reaching the same value. The relation with d^3 would be valid only as a limiting law for very narrow channels, since, as the diameter decreases, we find *linear* variation up to 5 mm., this variation gradually changing to d^2 at 0·5 mm.

We think that, even with corrective terms, one can hope to attain only the order of magnitude of the two-dimensional viscosity of the film. The calculation made by Kirkwood is valid only for a deep channel, which is not the case for the viscosimeters used by us and by Harkins. The theory introduced by Bresler and Talmud[3] would give results in better qualitative accord even for large channels, although it introduces arbitrarily a frictional term proportional to the speed in the differential equation. Unfortunately, an error in the integration prevented these authors from observing the accordance cited above.

The correct integrated form should be:

$$Q = \frac{2\varphi}{SA\varkappa}\left[R - \sqrt{\frac{\eta}{A\varkappa}}\tanh\sqrt{\frac{A\varkappa}{\eta}}R\right],$$

where φ is pressure gradient; S is surface per gram; A is a constant; $\varkappa$ is the viscosity of water; $R = d/2$; η is viscosity of the film. This gives for large channels the approximate expression:

$$Q = \frac{2\varphi R}{SA\varkappa},$$

and for infinitely small channels

$$Q = \frac{2\varphi R^3}{3S\eta}.$$

Nevertheless, in spite of this theoretical difficulty, one can, by using the experimental values of the flow for a given channel, detect very accurately changes of state in monolayers. We have shown[4], for example, that a liquid film of triolein exhibits at about 115 A.[2] a sharp change in the variation of the viscosity. In the same manner, a fluid film of stearic acid on 0·001 N hydrochloric acid gives changes at about 20·5 and 22 A.[2]. Thus, from this point of view alone, the measurements of surface viscosity constitute already a very promising new method of investigation.

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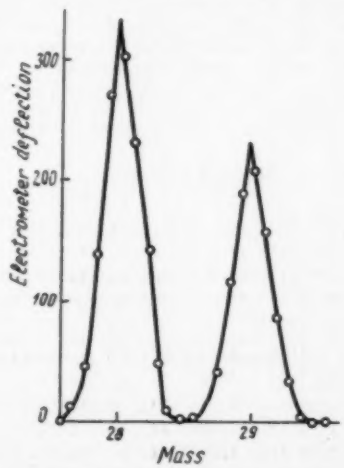
[1] NATURE, 140, 465 (Sept. 11, 1937); 141, 38 (Jan. 1, 1938).
[2] Dervichian and Joly, *C.R.*, 204, 1318 (1937). See also Joly, M., *J. Phys.*, vii, 8, 471 (1937).
[3] Bresler and Talmud, *Phys. Z. Sow.*, 4, 864 (1933).
[4] Dervichian and Joly, *C.R.*, 206, 326 (1938).

Direct Evidence for the N_2H^+ Ion in the Discharge Reaction between N_2 and H_2

So far as I am aware, no attempt has been made to study chemical reactions and in particular dis-



charge reactions by means of the mass-spectrograph. Thus Lunt[1], in reviewing the numerous theories of discharge reactions including ion clusters, excited or

metastable molecules, kinetic ions, etc., considers that there are no direct grounds for assuming the existence of compound ion formation except in the case of H_3^+.

Using a mass-spectrograph of the Dempster type, it has been found that N_2H^+ is produced abundantly when a mixture of N_2 and H_2 is bombarded with electrons. The accompanying graph shows the type of curve obtained in $N_2 + 5H_2$ at a total pressure of about 8×10^{-3} mm. From the intensity-pressure curve it appears that N_2H^+ owes its origin to N_2^+ and not to H_2^+, and from the ionization function curve, that the reaction starts at the ionization potential of N_2.

Since compound ions of higher and lower mass were found in only very small quantities, it may be concluded that the formation of N_2H^+ is only the first stage in the production of NH_3. The second stage presumably takes place at the walls in the presence of atomic hydrogen, in agreement with the results of Mochan and Gelbert[3].

The probability of the formation of N_2H^+ is even higher than that of H_3^+. Thus the ratio N_2H^+/N_2^+ is 4·3 times the ratio H_3^+/H_2^+ in that part of the pressure range which is free from selective absorption effects.

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[1] Lunt, *Trans. Far. Soc.*, **33**, 1691 (1936).
[2] Mochan and Gelbert, *Acta Phys. chim.*, **7**, 767 (1937).

Connexion between Electromagnetic and Neutrino Fields

As previously stated, one arrives at the formulation of specific 'coherence' (parallel motion) of two neutrino particles forming a photon, if both neutrino mass μ and neutrino 'charge' ε (non-electromagnetic) are put equal to zero but their relation to one another is kept constant[1], $\left(\frac{\varepsilon}{\mu} = \pi\sqrt{\frac{2c^3}{k}}\right)$.

Developing the consequent neutrino theory of light, one must now establish the expressions connecting all components of the electro-magnetic field $\Phi_{\mu\mu'}$ with neutrino wave functions ψ.

All requirements (that is, Maxwell's equations and the commutation rules) are fulfilled if one defines the antisymmetric field tensor by the following equation :

$$\Phi_{\mu\mu'} = i\varepsilon\left(S_\nu \frac{\partial}{\partial x_\nu}\right)^2 \Box^{-1}\varphi^+ \alpha_\mu \varsigma_3 \alpha_{\mu'}\varphi,$$

where $S_\nu \frac{\partial\varphi}{\partial x_\nu} = \psi$; α_μ, ς_3 are Dirac matrices and (S_μ) is an auxiliary constant vector, the direction of which corresponds to the definite choice of gauge for electromagnetic potentials[2].

From the neutrino wave function we can further construct two scalars defined by the formula :

$$\Phi = \varepsilon\, S_\nu \frac{\partial}{\partial x_\nu}\, \Box^{-1}\varphi^+ S_\mu \beta_\mu \varphi,$$

where (1) $\beta_\mu = \alpha_\mu$ and (2) $\beta_\mu = \varsigma_1\alpha_\mu$.

These latter quantities are connected with the longitudinal component of the electromagnetic field.

The above relations yield Coulomb's law for the static case, if the distance between interacting electrons is less than $\hbar/\mu c$, so that Maxwell's electrodynamics is limited from this point of view on the side of very great wave-lengths, which magnitudes depend from the mass of neutrino.

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Tomsk.
March 26.

[1] Sokolow, A., NATURE, **140**, 810 (1937).
[2] Sokolow, A., "On the Neutrino Theory of Light (3)", *Phys. Z. Sowjetunion*, in the press.

IN Jordan's form of the neutrino theory of light[1], the emission of a photon appears as the absorption and re-emission of a neutrino, or the simultaneous emission of a neutrino and an antineutrino, with identical directions. If the energy E and the momentum $\mathbf{p}$ transferred in the process are related by the equation

$$E = c|\mathbf{p}|,$$

as required by the usual theory, the mass of the neutrino must be assumed zero.

The angular momentum of a photon, in the direction of propagation, is either $\hbar$ or $-\hbar$. Assuming the neutrino to have spin $\frac{1}{2}\hbar$, this implies that the neutrino reverses its spin in the first kind of process, and that in the second kind the two particles have parallel spins.

From the mathematical point of view, the aim of the theory is to express the photon amplitudes, satisfying the commutation relations of the Bose-Einstein statistics, in terms of the neutrino amplitudes, satisfying the commutation relations of the Fermi-Dirac statistics, in a manner consistent with these physical assumptions. This can be shown to be impossible. The impossibility arises from the contradictory requirements of the conservation of angular momentum and the commutation relations. Certain pairs of two-rowed matrices occur, which by the first condition are required to be of the form

$$\begin{pmatrix} 0 & a \\ b & 0 \end{pmatrix} \cdot \begin{pmatrix} 0 & -ia \\ ib & 0 \end{pmatrix};$$

the second condition requires that a and b should be different from zero and that the matrices should commute with one another, and this is easily seen to be impossible. No special form for the Hamiltonian function of the neutrinos need be assumed. A more detailed account has just appeared in the *Proceedings of the Royal Society of London*[3].

The three-dimensional neutrino theory proposed by Kronig[3], which at first seemed to offer a complete solution of the problem, is seen, on closer inspection, not to be invariant against changes of co-ordinates. It also violates the conservation law for angular momentum.

This result does not apply to the theory of Sokolow (cf. previous letter). The main difference between the theories of Sokolow and Jordan is in the mass of the neutrino. In the former it is essential that the rest-mass, however small, should be finite, whereas in the latter it is zero. It seems, if the neutrino theory is to be retained, that some deviation from Jordan's hypothesis, such as Sokolow's, must be tried.

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[1] Jordan, P., *Z. Phys.*, **93**, 464 (1935).
[2] Pryce, M. H. L., *Proc. Roy. Soc. A*, **165**, 247 (1938).
[3] Kronig, R. de L., *Physica*, **3**, 1120 (1936).

Science, Logic and Philosophy

My attention has been directed by Mr. John Bradley of Christ's Hospital, Horsham, to a passage by Prof. J. H. Muirhead[1], containing the words: "The truth is that what is called a natural law is itself not so much a statement of fact as of a standard or type to which facts have been found more or less to approximate. This is true even in inorganic nature." My statement[2] that the variation of observations from a mathematical formula is quite unknown to philosophical critics has therefore at least one exception, which I am glad to acknowledge. But much in philosophical works would receive additional force from its recognition; for example, in the later parts of Prof. L. S. Stebbing's "Philosophy and the Physicists". Mr. Bradley directs attention also to a passage in Plato: "I have never been able to find out anything for certain and have had to be content with the probable." Locke said the same thing at greater length, and W. E. Johnson made important constructive contributions to the quantitative theory; so I did not intend to disparage the contributions of philosophers to this side of the question.

My opening passage should have been expressed somewhat differently, and should be read in conjunction with the closing one. Two correspondents have referred to it as a refutation of idealism, but it is only a refutation of a particular form of it. I show in the course of the article that the scientific use of generalization can permit even an idealist to escape from solipsism, and my final conclusion is that there are forms of realism and idealism that are scientifically equally valid. My own preference is for the realist one, but I admit that that is pure prejudice. On the other hand, I am not sufficiently familiar with idealist literature to say whether any actual idealist would accept the form of idealism that I consider tenable.

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Cambridge.

[1] "The Elements of Ethics" (1910), pp. 37–38
[2] NATURE, **141**, 672–676, 716–719 (1938).

A Binocular Illusion

THE interesting binocular illusion described by Prof. Dixon[1] is usually called the wall-paper experiment in England and *Tapetenbilder* in Germany. It has frequently been rediscovered—often by children—and I know of a number of people who have found it out for themselves.

Exactly two hundred years ago Robert Smith[2], afterwards Master of Trinity College, Cambridge, described the illusion of binocularly fusing two candle flames by converging the visual axes on a nearer point. The effect was that of a smaller candle closer to the observer. H. Meyer[3] in 1842 published a detailed account of the phenomenon as seen in patterned wall-papers. Two years later it was seen by D. Brewster[4] in wall-papers, carpets, and other patterned objects. He described the curious unreality of the appearance—a semi-transparent object suspended in the air and moving with every movement of the observer. He always claimed to be the original discoverer, and made no reference to Smith or Meyer.

The chief physiological interest of the illusion is that it has seemed to several writers to indicate that the amount of convergence of the eyes necessary to avoid diplopia is an important datum in the visual judgment of distance. It is possible, however, that the illusory closeness of the percept is mainly due to the fused pattern being judged to be at about the known distance from the observer of the fixation point, or of other objects the images of which fall on corresponding points of the two retinas.

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May 4.

[1] Dixon, H. H., NATURE, **141**, 792 (1938).
[2] Smith, R., "A Compleat System of Opticks" (Cambridge, 1738), vol. 2, Remarks, p. 86 and Fig. 161.
[3] *Arch. physiol. Heilk.*, **1**, 316–326 (1842).
[4] *Trans. Roy. Soc. Edin.*, **15**, 663–675 (1844); *Phil. Mag.*, **30**, 305–308 (1847); "The Stereoscope" (London, 1856), Chap. vi.

Ounce Molecular Weight of a Gas

THE useful equivalence, gm. per litre = oz. per cub. ft. (approx.), as a practical connecting link between metric and British weight-volume relationships, referred to by Dr. H. D. H. Drane in NATURE of April 30 (p. 791) is well known to industrial chemists and engineers, and appears in Woodward's "Logs and Tables for Chemists" (1917), p. 62.

The much older expression of the same equivalence, pounds per cub. ft. × 16 = kgm. per cub. metre has appeared in various engineers' handbooks for more than twenty-five years (for example, Frye's "Civil Engineers' Pocket-Book" (1912), p. 89). Easily remembered equivalents of this kind constitute one of the first lessons learned by a laboratory worker when he goes into industry.

In the case of gases, where we generally deal with large volumes, Lunge's simple calculation ("Alkali Maker's Handbook" (1891) p. 26) based on the same equivalence of gram and ounce molecular weights, is most useful. The molecular weight of a gas divided by 4 gives the approximate weight in cwt. of 10,000 cubic feet. This may also be applied to mixtures of gases. For example, the average molecular weight of dry air, calculated as one fifth oxygen and four fifths nitrogen, is 28·8, and $\frac{28{\cdot}8}{4} = 7{\cdot}2$ cwt. per 10,000 cub. ft. The precise figure at N.T.P. is 7·206 cwt.

The volume of an ounce molecular weight of oxygen as visualized approximately by Dr. Drane is 22·5 cub. ft. weighing approximately 2 lb. The actual weight at N.T.P. is 2·008 lb. and calculated by Lunge's method is 2·016 lb.

I entirely agree with Dr. Drane that notes of such relationships between metric and British units might well appear in the text-books.

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April 30.

THE fact that the molecular weight of a gas or vapour in ounces occupies 22·4 cub. ft. at S.T.P. seems to have been pointed out first by Prof. J. W. Richards in an article on "Some Abridgments in Chemical Calculations", published in the *Journal of the Franklin Institute*, **152**, 109 (1901). It is quoted

as far back as the 1912 edition of Dr. J. W. Mellor's "Modern Inorganic Chemistry".

Apropos of abridgments, it does not appear to be generally known that the conversion factor from Calories per cub. m. to B.Th.U. per cub. ft., namely, 0·11236, can be represented by 1/9 + 1/800 to an accuracy of better than one part in 100 thousand.

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Science Subjects at External Arts Examinations

IT will be generally agreed that workers in the field of pure science should be recruited so far as possible from the educated population as a whole and not from particular social or economic classes within this whole: where the range of intellects is wider, the resultant products are likely to be more varied and richer. Equally it is agreed that the primary aim of science is the advancement of pure knowledge as a whole, not merely of highly developed branches demanding equipment, the expense of which will tend increasingly to place originally disinterested workers in the power of less disinterested 'patrons'.

If we admit this, shall we not be the more insistent in requiring that regulations for examinations be drawn up so far as possible upon lines tending to offer wide scope to individual talent, and not upon lines which only too often seem to have *elimination*—stressing the negative sense of the word—as their principle? Referring specifically to conditions in the University of London, the arbitrary and highly undesirable selection of workers which the expense of a science degree at present often renders unavoidable might be compensated for in some measure by a far-reaching extension and broadening of the regulations for external degrees *in Arts*, and should include a relaxing of certain present restrictions as regards special fees or a transferring of these to other subjects, a knowledge of which is not so much sought after or so socially urgent.

I make the following preliminary suggestions:

(1) Sociology should be included as a subject for the B.A. General Examination. (2) Anthropology should be forthwith freed from its special fee of an *additional* five guineas. (3) Honours candidates who are prohibited by expense from taking subjects where a practical examination is necessary, should be allowed to take sociology without having to show a knowledge of Kant's "Critics". (4) Students of languages (who often show as marked an aptitude for science as they do little capacity for literary appreciation) should be offered more attractive and varied syllabuses: optional papers on the geography, history, ethnology, sociology of the country, etc.; on the lines of the present Slavonic syllabuses. (5) Some attempt should be made to separate such parts of a science as are capable of purely theoretical and critical treatment and to form these into material for the creation of additional science subjects, which may be taken by those unable to take the practical work at ordinary science examinations. It seems, in this latter case at any rate, time that such a promising division of labour were given further consideration.

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Points from Foregoing Letters

LORD RAYLEIGH finds that igneous rocks in general contain about 3×10^{-3} c.c. of nitrogen per gram, mostly held in chemical combination. The ratio argon/nitrogen is much less in the earth's crust than in the atmosphere. The total nitrogen content of the rocks is many times greater than that of the atmosphere.

Prof. K. Przibram states that the different colorations of fluorites are due to the varying intensities of the absorption maxima of the bivalent rare earth ions and of the reduced calcium, and explains various colour and luminescence effects by electron transfer from the bivalent rare earth ions to the calcium and back.

Prof. E. F. Burton reports the results of experiments on the velocity of sound in the two forms of liquid helium, helium I and helium II. A graph is submitted giving the variation of this velocity with temperature; the slopes of the curves are different in the two liquids and there is an indication of a slight discontinuity at the λ-point. The value at the λ-point is 221 metres per second.

An absorption curve for Group *A* neutrons in silver with thin detectors (0·01 gm./cm.^{2}) and with thin absorbing foils (down to 0·006 gm./cm.^{2} has been obtained by Dr. H. Paxton. The absorption coefficient of 60 cm.^{2}/gm. determined from the beginning of this curve is supposed to set a lower limit for the value which would be measured with negligibly thin absorbers and detectors.

A graph showing the yield of positrons from radiophosphorus of mass 30 (obtained by the action of polonium α-rays upon aluminium), as a function of the average range of the exciting α-particles, is given by A. Szalay.

By using a Cartesian diver method for detecting minute pressure variations, so that a change of one millionth of a c.c. of gas can be observed, Dr. J. Needham, E. J. Boell and Veronica Rogers are investigating the chemical changes in different parts of the developing amphibian embryo (gastrula).

Prof. B. C. Guha and P. N. Sen-Gupta bring further evidence in support of the view that cabbage, and also certain animal tissues, contain ascorbic acid in combined form (ascorbigen) and in addition a non-specific reducing substance in combined form. The authors outline a method for the estimation of the 'total' ascorbic acid.

D. G. Dervichian and M. Joly point out that while the flow of surface monolayers is proportional directly to the difference in pressure and inversely to the length of the channel, the dependence of the flow upon the width of the slit is complicated owing to the entrainment of water. The rate of flow gives useful information concerning change of state in monolayers.

A. Sokolow derives a connexion between electromagnetic and neutrino fields for the three-dimensional case in relativistically invariant form by assuming that the rest-mass of the neutrino is zero.

Research Items

Albanian Gypsies

MRS. MARGARET HASLUCK has prepared an account of the gypsies of Albania, based partly on literary sources, and partly on her observations, of which the first instalment has appeared (*J. Gypsy Lore Soc.*, Ser. 3, 17, 2; 1938). In Albania there are, broadly speaking, two classes of gypsies, readily distinguishable as nomads living in tents and speaking Romani as their mother tongue, and the sedentaries who live in houses and huts, and have forgotten Romani. The gypsies form a relatively large proportion of the Albanian population, as they number some 20,000 out of a total of one million. The two classes of gypsies are given different names by the Albanians, and these also vary in form and meaning according to locality. Several of these names are to be traced to the root seen in the English word "Egyptian". The houses of the sedentaries, like those of the poor Albanians, are one-storied cottages, with living-room and kitchen. They contain little furniture. In the towns the gypsies form a separate quarter. Sometimes nomads may live in a house for a period, possibly some months, and then revert to tent life. The huts are of wattle and daub, about seven feet high, and, unlike the houses, have no furniture. The tents are usually of the simplest type, the tent being thrown around the pole like a cloak, with an ever-open door. Occasionally a tent with a ridge-pole on two forked uprights is used. Quilts and straw-mats are the only bedding carried, leaves and branches serving for mattresses. The chief utensils are a pot and frying-pan. Thus at need a donkey can transport all the goods of a family. No cradles are used, and small children are carried in a sling thrown over one shoulder, which allows the child's feet to rest on the mother's hip. As linguists, the nomads surpass the sedentaries. The average nomad is taller than his sedentary counterpart, and has a lither body and darker complexion. So dark are they that a nomad woman is sometimes styled "as black as the kitchen crook". Owing to this their tongue appears unusually red and their teeth very white. Hence the Albanian belief that the gypsies have a redder tongue and better teeth than themselves. Some of the sedentary gypsies have fair hair and skin and blue eyes. This colouring others endeavour to obtain by sympathetic magic, putting a silver coin in the milk on St. George's Day and then hanging it round their necks to prevent sunburn.

Emotion and the Secretion of Urine

THE fact that emotional stress and muscular exercise can inhibit the secretion of urine has been known for many years, but its cause has remained obscure. Rydin and Verney (*Quart. J. Exp. Physiol.*, 27, 343; 1938) have now carefully analysed this phenomenon. They find that the nerve supply of the kidney is not concerned in the effect, but that it is due to some circulating substance, other than adrenaline, reaching the kidney through its blood vessels. The inhibition produced by emotion can be imitated with considerable exactness by the intravenous injection of minute quantities of the active principle of the posterior lobe of the pituitary gland, and this has led the authors to suggest that a discharge into the blood stream of the anti-diuretic principle of the pituitary is the normal accompaniment of such emotional stress. The existence of nervous connexions between the hypothalamic nuclei and the pituitary body adds cogency to this suggestion, and the probability that it is a normal physiological event is supported by the extraordinary potency of very minute amounts of posterior pituitary extract. The authors calculate that an effective dose would mean the exposure of the cells of the kidney to only 30 molecules each of the anti-diuretic principle.

Density of Small Living Organisms

THE *Proceedings of the Linnean Society*, 1937–38, Part 2, contains a very clear description, by Mr. A. G. Lowndes, of an experimental method by which the density of small living organisms may be determined, using the normal specific gravity bottles, in which the organisms are weighed in their natural fluid. The volume of the organism is determined by immersing it either in sea water, if a marine organism, or in a glucose solution and afterwards determining the volume of fluid displaced by the organism by a titration. A certain number of densities are given and also results of experimental test of the accuracy of the method by a comparison of the density of glass beads determined by this method and by direct determination of volume displacement and of weight. The table of densities shows that the stickleback is always denser than its natural medium, and must continually keep itself up by its own muscular effort; a more striking result is that the sinking factor in the stickleback is less at 20° C. than at 10° C. so that the higher the temperature the less the muscular effort required to keep afloat. It is argued cogently that, with small organisms of low density, surface area is the dominating factor so far as body orientation is concerned, rather than the position of the centre of gravity, so that spines or plumose setæ increasing the surface will have considerable significance in relation to orientation. (See also NATURE, Feb. 12, p. 289.)

Non-Setting of Pears

CERTAIN varieties of good quality pears blossom profusely, but are most irregular in setting their fruit. D. N. Srivastava (*J. Pom. and Hort. Sci.*, 16, 39; 1938) has investigated the problem at East Malling, using one free-cropping variety (Conference) and two shy-cropping varieties (Doyenné du Comice and Pitmaston Duchess). Two waves of dropping were observed, (1) a very early shedding of non-fertilized flowers, (2) a late and comparatively light dropping of partially developed fruits, popularly known as 'June drop'. The main cause of June drop did not appear to be lack of fertilization, since plenty of apparently healthy seeds were found in most of the fruits dropped. Individual fruit size was correlated with length of life on the tree, the larger fruits remaining attached longest, from which it is inferred that dropping is due to competition for nutrients. Cutting back the main branches to eight year old wood increased the set of fruit the same year, but reduced the number of fruit buds the following year. Ringing increased fruit-bud formation but did not

improve the set of fruit, whilst bending over and tying down the main branches gave variable results both for fruit-bud formation and for fruit set. It is thought that the problem is a nutritional one.

Geological History of Indian Rivers

IN the symposium which followed the presidential address to the National Institute of Sciences of India (NATURE, **141**, 797, April 30, 1938), Mr. D. N. Wadia of the Geological Survey reinforced Prof. M. N. Saha's plea for detailed investigations of Indian rivers by emphasizing how many important changes have taken place within historic times. In common with Saha, he accepts the hypothesis of a great river in early Pleistocene times (the Indobrahm of Pascoe or the Siwalik River of Pilgrim) which flowed from the east—somewhere in eastern Assam or China—along the courses of the present Middle Brahmaputra, the Ganges and the Indus to discharge into the Arabian Sea. Wadia considers that tectonic movements are still taking place in the Himalayan foredeep. After the separation of the Indus and Ganges groups, the Jumna continued for long a tributary of the Punjab rivers. So late as the twelfth or thirteenth centuries A.D. the Sutlej appears to have flowed as a great river (the Hakra) into the Rann of Cutch. Wadia points out that the Himalayan rivers are cutting back and that there is a real danger of the Kali Gandak tapping the head waters of the Brahmaputra in Tibet and bringing that river—with consequences which can scarcely be even imagined—into the Gandak and Ganges. Another example of rapid changes is afforded by Rennell's map of Bengal (1786) and utterly different from the present. Dr. S. L. Hora of the Zoological Survey of India finds the hypothesis of the Indobrahm supported by the distribution of fish and that the Indus and Ganges were only separated at a very late period geologically. If such major changes are still taking place, it is clear how modern engineering works may be jeopardized without the nature of the changes being thoroughly understood.

Local Variations of Temperature

AN account of local variations of temperature within an area of a few square miles in the neighbourhood of Nottingham was read before the Royal Meteorological Society by A. B. Tinn on April 27. There were eight observation stations with a range of height above mean sea-level of only 130 ft., yet it was found that the daily minimum temperature showed local differences of more than 4° F. in the monthly mean and of 10° F. on individual days. The records of four of the stations were analysed over a period of two years—April 1935–March 1937—to discover the conditions most favourable for large differences. For minimum temperature these were winds from between north and east, fine weather, a high barometer and low humidity, although the conditions giving low minima did not always result in large differences. Rainy and windy conditions bring the differences to a minimum. Daily maximum temperatures show large differences less often, but such differences are occasionally found to amount to between 4° and 6° even in summer and to 8° or 9° in winter, extreme differences being most likely when some places remain in fog while others are in sunshine. The topography of the region does not contain any remarkable features, the high ground consisting of irregular spurs extending north-north-east from Nottingham Castle while the lowest ground is to the south bordering the River Trent. Its share in producing the observed differences did not show very clearly, doubtless owing to the limited number of stations compared with the variety of topographical nature. Attenborough, only 89 ft. above sea-level, showed the most Continental climate.

Condensation on Board Ship

A RECENT lecture before the Royal Society of Arts by J. S. Duly on "Condensation on Board Ship" contained several interesting illustrations of how well-known physical principles may be applied to large-scale commercial undertakings. He pointed out that cargoes in unrefrigerated holds have such considerable heat capacity that the temperature alters but little, even during a relatively prolonged voyage. Consequently in the tropics, the cargo is at a temperature below the dew point of the warm moist sea-air, and it follows that condensation can best be avoided, not by ventilation, as is usually assumed, but by its opposite, that is, by preventing the entrance of this air. A second point made by Mr. Duly was that for each commodity, the equilibrium moisture content is a function of the relative humidity of the air and (to a small extent) of its temperature. Consequently, in a closed space, a condition is reached in which the moisture content and the atmospheric humidity are in equilibrium. In other words, each commodity maintains around itself an atmosphere of appropriate humidity. Further, the outer layers of a cargo in bulk tend to protect the main mass from changes in moisture content, since any alteration on the outside affects the atmospheric humidity in such a direction as to oppose further change. On Mr. Duly's views, these facts account for damage by condensation being so small as is found in practice. He deduces, besides the conclusion mentioned above, that care should be taken in ship design to avoid either very hot or very cold surfaces anywhere on the walls of the cargo space, and also that the choice of the material from which containers are made is not a matter of indifference.

Orbits of Double Stars

DR. HENRY NORRIS RUSSELL has recently described a method for the rapid determination of visual binary orbits (*Mon. Not. Roy. Astro. Soc.*, **93**, 8, June 1933). This graphical method was so easy to apply that two complete orbits could be computed in one day. Dr. R. v. d. Woolley has modified Russell's method for cases where the eccentricity is high, and by assuming that this is unity his graphical method is simple and capable of rapid application ("A Parabolic Double-Star Orbit", *Mon. Not. Roy. Astro. Soc.*, **98**, 5, March 1938). This is applied to the double star Σ 1639. The values of the position angle and separation deduced from the elements are compared with nine normal places, and there is a very good agreement in both co-ordinates. It is not, of course, implied that the orbit is definitive, but if the object is carefully observed for a few years it is possible that the eccentricity can be determined. It is also suggested that σ_1 *UMa*, to which Halpern fitted a parabolic orbit about six years ago, should be observed for some years in order that its eccentricity may be computed.

Progress in Physics

Tributes to Max Planck

THE recent issue of the *Annalen der Physik* has been dedicated to Prof. Max Planck in honour of his eightieth birthday on April 23 (see NATURE, April 23, p. 720). Some of the twenty-two papers offered to him by his friends, colleagues and pupils may be picked out for mention here.

(1) The first paper is by N. Bohr on the quantum of action and atomic nuclei. Bohr contrasts the situation in the early days of interpretation of atomic spectra with the present situation of nuclear theory. In the atom, the weak and long-range Coulomb forces between the particles made possible the successful application of the correspondence principle. This failed only at an advanced stage of interpretation, when it was superseded by a fundamental revision of the laws governing observation in physics.

The nucleus, on the other hand, is held together by strong short-range forces with saturation properties, which couple the constituent parts to form an indivisible system. Gamow's theory of α-ray spectra gave an indication of the energy levels of this system. These cannot be explained on the assumption of individual particles moving in a fixed field of force as of the Coulomb type. The strong coupling of the particles and easy transfer of energy between them is revealed in the transformation processes of nuclei under neutron bombardment.

Fermi showed that the impinging energy of the neutron is spread over the whole nucleus, with formation of an unstable nucleus. This strong coupling thus makes a nucleus similar to an elastic system in dynamics, in which the effect of a shock will be distributed over a great number of proper frequencies forming an extended and finely graded spectrum. The energy of the bombarding particle 'heats' the nucleus and an 'evaporation' of some of the nuclear constituents may follow this process (cf. NATURE, 137, 344 and 351 (1936).

(2) In the second paper, W. Heisenberg discusses the relevancy of the length $r_0 = e^2/mc^2 = 2{\cdot}81 \times 10^{-13}$ cm., which he considers to be one of the 'primary universal constants'. By this term are designated universal constants implying some kind of invariance of the physical laws. Examples are c, determining the Lorentz-invariance and h, determining the interchange relations and the invariance of the quantum laws against rotation in the Hilbert space. These 'primary universal constants' indicate the limits where the laws formulated for our initial domain of experience break down ($v \approx c$, $E \approx h\nu$). The length r_0 may be taken to indicate the limit down to but not beyond which the usual quantum mechanics hold. The new laws governing physics at distances less than r_0 may be expected to manifest themselves in the following phenomena :

(*a*) Self-energy and radius of the electron, Sommerfeld's fine structure constant, $\alpha = e^2/hc$. (Since $e < \sqrt{hc}$, classical explanations for these are not to be expected.)

(*b*) β-Disintegration. The present difficulties arise from imposing arbitrary limits on certain integrations ; this treatment may be considered as a kind of correspondence to the treatment taking account of the new laws below r_0.

(*c*) Masses of elementary particles may be hoped to follow from r_0 in a similar way as the term values of hydrogen from h by way of the Rydberg constant.

(*d*) Interaction of particles provided the energy implied is of the order hc/r_0. This will be the case for the ordinary interaction in nuclei and for collision between particles rich in energy. Disintegration by 'explosion' may be expected if the nuclear field 'separates' from the nucleus on approaching another nucleus by less than r_0.

(*e*) Lengths less than r_0 will not be measurable, even by the γ-ray microscope, since the act of measuring would lead to nuclear explosions.

(*f*) A clue to the ultimate invariance property connected with r_0 will perhaps be obtained from relations between the observable values such as cross-sections for cosmic ray processes.

(3) R. A. Millikan discusses the "1938-values" of the fundamental constants. Acknowledging fully the importance of recent X-ray measurements by DuMond and Bollmann and by von Friesen, he arrives at :

$$e = 4{\cdot}796 \pm 5 \times 10^{-10} \text{ E.S.U.}, \quad h = 6{\cdot}610 \pm 12 \times 10^{-27} \text{ erg. sec.}, \quad N = 6{\cdot}097 \pm 6 \times 10^{23}.$$

(4) Two papers deal with the influence of conditions imposed on the solutions of the Schrödinger equation. E. Schrödinger finds that ψ need not necessarily be limited to single-valued functions in order to obtain unambiguous physical predictions. It is not possible, however, to have more than double-valued functions, of opposite sign in the two branches, and the same problem admits of either mono- or divalent functions only for all its states.

A. Sommerfeld and H. Welker surround an hydrogen atom by an infinitely high and steep spherical potential wall, and show that the ground state for this 'enclosed hydrogen atom' is expressed by confluent hypergeometric functions. With decreasing radius of the wall, the energy rises from its normal negative value and becomes positive when the available distance of the electron from the centre is limited to 1·835 times the normal ground state radius.

(5) Several papers are devoted to thermodynamical and statistical problems. W. Meissner goes into the details of the growth of solid carbon dioxide into liquid carbon dioxide as realized in the 'Agefko' process. A very large heat gradient exists over a boundary layer of 0·1 mm. in thickness which is traversed by capillaries 1 μ in diameter. General equations for stationary thermodynamical processes at the moving boundary between two phases are given.

Statistical considerations initiated by Gibbs and Vollmer for problems of condensation are applied by R. Becker to the segregation of the constituents of a mixed crystal. The rate of formation of crystal nuclei for further growth can be determined as a

function of under-cooling for a crystal in which the binding forces act between neighbouring atoms only. This compares well with the measurements.

M. v. Laue gives a study of the thermodynamics of supra-conductors, F. Hund the theory of diamagnetic properties of very small pieces of metal at low temperatures. The heat anomalies found for alums at very low temperatures by Simon and his co-workers are attributed to the internal electric and magnetic fields of the crystal acting on the trivalent metal ion by P. Debye in a paper on cooling by adiabatic demagnetization. A detailed discussion of the iron-ammonium alum gives the Curie point at 0·038° K. as against the value 0·034° K. given by Simon from his observations. The magnetic coupling of the atoms leads to the formation of spontaneous order below a temperature of some thousandths of a degree, and prohibits a further cooling by demagnetization, which therefore will only be possible by action on the magnetic moments of the nuclei.

(6) Limitations of space forbid mention of further papers, save one by K. Schmeise and W. Bothe on a new kind of ultra-hard cosmic ray shower which seems to originate in the hard component of the primary cosmic rays. These showers scatter over an angle of about 10°, half that of normal showers, and are transformed into the ordinary soft showers on passing through matter.

The Problem of Stellar Energy

THE problem of stellar energy was the subject of discussion of the Fourth Annual Conference on Theoretical Physics sponsored by the George Washington University and the Carnegie Institution of Washington, and held in Washington, D.C., on March 21–23. The Conference was attended by astrophysicists studying the internal constitution of the stars (S. Chandrasekhar, B. Strömgren, T. Sterne, D. Menzel and others) as well as by physicists working on different branches of nuclear physics (H. Bethe, G. Breit, G. Gamow, J. v. Neumann, E. Teller, M. Tuve, L. Hafstad, N. Heydenburg and others).

On the fundamental problem concerning the nuclear transformations as the source of energy of stars, some interesting conclusions have been reached. According to the so-called "aufbauhypothese", the process of the building up of the heavier elements from hydrogen is continually taking place in stellar interiors. Further, it is assumed that such processes liberate sufficient amounts of energy to account for the radiation of the stars. However, it seems that the model scheme proposed by von Weizsäcker ($^4_2\mathrm{He} + {}^1_1\mathrm{H} \rightarrow {}^5_3\mathrm{Li} \rightarrow {}^3_2\mathrm{He} + \beta^+$) is contradicted by recent experimental evidence, according to which the nuclei $^5_3$Li and $^5_2$He are both unstable, emitting heavy particles in a very short time. Another possible chain of reactions for the synthesis of the heavier elements from hydrogen and helium would require the stability of $^8_4$Be, which is again very doubtful according to recent experimental evidence. It appears, then, that the only course not excluded by present evidence on the binding energies of the light nuclei is the formation of $^9_4$Be in triple collisions involving an α-particle and two protons.

Although the existence of $^9_4$Be has not yet been established experimentally, there are some indications that it might be a stable nucleus. If so, the chain of reactions leading to the synthesis of the heavier nuclei from hydrogen can be traced. The estimate of the probability of such reactions involving triple collisions shows that, under the conditions in the stellar interiors, the rate of liberation of energy will be sufficient to account for the radiation of the stars.

As another possibility the reaction $^1_1\mathrm{H} + {}^1_1\mathrm{H} \rightarrow {}^2_1\mathrm{H} + \beta^+$ was suggested. It seems that the rate of such a reaction under the conditions in stellar interiors would be just enough to account for the radiation of the sun, though for stars much brighter than the sun other more effective sources of energy are required.

Special attention was directed to the possibility of resonance effects for nuclear reactions occurring in the interior of the stars; in such cases it would be necessary to consider that some light nuclei have virtual levels in the region of 10 kv. (corresponding to temperatures of the order 4×10^7 degrees Kelvin). The presence of resonance levels would not only increase the rate of liberation of energy of the reaction in question, but also would at the same time require a rather different type of stellar model. The rate of ordinary nuclear reactions increases exponentially with temperature, leading effectively to a point-source model in which the energy sources are concentrated at the centre. The selectivity with respect to temperature which would arise from resonance levels at about 10 kv. would, on the other hand, suggest a shell-source model with the maximum liberation of energy in a spherical shell surrounding the centre. It seems that this new model has a number of advantages over the point-source model.

The possibility of an extremely dense neutron core at the centre of the star (as proposed by L. Landau) was also discussed. The study of a number of known stars does not indicate a central condensation of more than what corresponds to 90 per cent of the total mass within half the radius. Thus, so far as astrophysical evidence is concerned, the model of a star with a heavy 'stellar nucleus' at the centre is *not* confirmed, except possibly for supergiants (for example, the *M*-component of νν Cephei, the infrared component of ε Aurigæ), for which cases the observational evidence allows one to infer a high degree of central condensation corresponding to 90 per cent of the mass within less than ten per cent of the radius. Further, a stellar model with a 'nucleus' would require extremely high temperatures and densities ($\sim 10^9$ degrees and $\sim 10^9$ gm./cm.^{3}) at the surface of the core. In such physical circumstances *all* nuclear reactions would occur at extremely high rates and the total liberation of energy would lead to predicted luminosities for stars of altogether different orders of magnitude from those observed. It was therefore concluded that stellar models with a concentrated nuclear core cannot represent real stars.

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G. GAMOW (George Washington University).
M. A. TUVE (Carnegie Institution of Washington).

Elliot Smith Memorial

ON Tuesday, May 3, in the Thane Library of the Faculty of Medical Sciences, University College, London, a bust in bronze of the late Sir Grafton Elliot Smith, professor of anatomy in the College from 1919 until 1936, was unveiled by Prof. J. T. Wilson and presented by him on behalf of the subscribers to the chairman of the College Committee (the Right Hon. Viscount Sankey of Moreton). Prof. J. P. Hill reported on behalf of the Committee that the subscribers to the Fund included old friends, colleagues and pupils of Elliot Smith from all the continents, and most of the countries of the world. The execution of the memorial was entrusted to Mr. A. H. Gerrard of the Slade School, and the bust is a striking portrayal of a man of vigorous personality and great intellectual capacity.

In making the presentation, Prof. Wilson, in a short speech of singular charm and warmth of feeling, remarked that Elliot Smith's best memorial is not material but spiritual and is to be found in the impressive record of his lifelong activity and in his influence on innumerable people besides his pupils, colleagues and friends. The qualities that his friends have recognized have been an extraordinarily penetrating vision and a capacity for interpretation, together with a striking vigour and clarity of exposition. Prof. Wilson made mention of the very varied character of Elliot Smith's career as an anatomist, first in Sydney, then in Cambridge, followed by Cairo, Manchester and finally London, and of how all these manifold experiences influenced the trends of his remarkable activities. He recalled that some forty-five years ago, Elliot Smith had been his pupil in the University of Sydney and afterwards his demonstrator, and speaking as the representative of his Alma Mater, he further recalled with pleasure that he had had the honour of recommending him for one of his first distinctions, the Gold Medal awarded for his thesis for the doctorate.

Lord Sankey, in accepting the bust on behalf of the College, said it was a remarkable memorial to a remarkable man and yet another treasure to the gallery of great and distinguished men who by their life and learning have contributed to the prestige of University College.

The Provost of the College, Sir Allen Mawer, in thanking Prof. Wilson and the subscribers, spoke of the part played by Elliot Smith in the negotiations with the Rockefeller Foundation which resulted in the munificent benefaction through which it was possible to build and equip the existing Department of Anatomy, and of his influence in promoting the close association which exists between the College and the universities of the Dominions and more particularly of Australia.

Immunological Reactions of the Filterable Viruses

ONE of the greatest services which a group of investigators can give to the larger scientific public is the compilation of a sound and detailed résumé of their own particular field of research. F. M. Burnet, E. V. Keogh and Dora Lush have done this for the immunological reactions of the filterable viruses (*Aus. J. Exp. Biol. and Med. Sci.*, 15, Pt. 3 (supplement), pp. 231–368; 1937: also published separately, price 10*s.* 0*d.*, from the Librarian, Univ. of Adelaide, South Australia, or Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, London, W.C.1). The specialist contribution of these workers lies mainly in their quantitative study of the immunity reactions of numerous animal viruses, using a method which produces discrete pock marks upon the chorioallantoic membrane of a developing egg. Their present monograph contains a short reference to the serology of plant viruses, but is otherwise devoted in detail to those which attack bacteria and mammalian animals. Chapter I contains a useful comparison of animal viruses with bacteriophages. The latter can be regarded as virus diseases of bacteria, and have particle-sizes commensurate with the small size of their hosts. They range from 10 to 65 mμ in diameter, where animal viruses vary between 10 and 300 mμ. Both are composed mainly of nucleoprotein, with traces of ether-extractable substances and salts, whilst carbohydrates are lost during washing.

The section describing the immunology of bacteriophage is, of necessity, more general than that setting forth the comparable reactions of animal viruses. Specificity of bacteriophage inactivation by immune sera, differences in antigenicity among bacteriophages, and the antigenicity of inactivated phage, are some of the main lines of discussion, whilst the details of typical phage-antiserum reactions are given at considerable length.

It is possible to be much more specific in the sections which deal with the immunology of animal viruses. The causal agents of influenza, cow-pox (vaccinia), louping-ill, rift valley fever, equine encephalomyelitis, Newcastle disease, infectious laryngotracheitis and myxomatosis, are each given a particular chapter, wherein their immunology is adequately portrayed. Chapters upon virus immunity from a biological point of view, on the site of formation of virus antibodies, on the principles of active immunization against virus infections, and on modern views upon the antigen-antibody reaction, minister to the more general reader in search of biological background.

Considerable lists of references to the literature are given, and if the Australian investigations are emphasized somewhat, workers in the northern hemisphere can only be grateful for their concomitant availability, and be glad of such fundamental contributions. It would indeed be difficult to over-emphasize the value of such monographs as the one under review; it serves to nullify any incipient bewilderment at the increasing volume of modern knowledge in its particular sphere.

Science News a Century Ago

Geographical Exploration

ON May 28, 1838, at a meeting of the Royal Geographical Society, six communications were read. These referred to the discovery of the outlet of the River Murray in Australia; the expedition of Thomson D'Abbadie to Abyssinia; a journey in north-west Persia by Lieut.-Colonel Shiel; some observations from Bagdad by Lieut. Lynch, who had examined the banks of the Tigris from its source to that city; a proposal from G. A. Hoskins sent in the name of the Society of Egyptian Travellers suggesting sending a native of Dongola to explore the western branch of the Nile, and a communication from Schomburgk in British Guiana dated November 18, 1837. Ascending the Rivers Essequibo, Rewa and Quitaro "we halted," wrote Schomburgk, "on the 7th Nov. in order to visit the Atáraipú, a natural pyramid, of which I had heard so many and such contradictory reports. Our road to it led through thick woods, until after a scramble of two hours we stood at the foot of a hill of gniess, barren with the exception of a few parasitic plants as Orchideæ, Cacti, Chusia, which draw their scanty nourishment from a thin layer of vegetable mould lying in the clefts of the rocks. After ascending for 300 feet, the view opened to the west, and from the abyss below rose the far-famed Atáraipú, one of the greatest natural wonders of Guayana. Its base is wooded for about 350 feet high from thence rises the mass of granite, devoid of all vegetation, in a pyramidical form, for about 550 feet more, making its whole height 900 feet above the plain . . . a little to the south of it another, almost similar of gneiss, of which, when we consider that all beyond was unknown ground, it might well be said, in the words of the poet, that they

"Like giants stand
To sentinel enchanted land."

Blowing up of a Sunken Vessel

CONSIDERABLE interest was taken in the blowing up by means of gunpowder, on May 28, 1838, of the coal brig *William*, which in 1836 had sunk in the River Thames off Gravesend, with about 300 tons of coal aboard. According to the *Mechanics' Magazine*, this was the first attempt to destroy a vessel under water. The task of destruction was entrusted to Colonel (afterwards General Sir) C. W. Pasley (1781–1861), director of the Royal Engineers' Establishment at Chatham. Two leaden cylinders each containing 2,500 lb. of gunpowder were made. These were completely enclosed in wooden cylinders of 3 in. timber, 4 ft. in diameter and 10 ft. long, bound with hoop iron. One of the cylinders was placed in position by divers and the charge was exploded by means of a fine powder hose in a flexible leaden pipe attached to the cylinder, the upper end of which was moored to a red buoy. The gunpowder train was connected with a small tin canister in the centre of the great charge. A sapper with a lighted taper set fire to the fuse, which burnt five minutes, allowing him to row out of danger. The explosion raised a dome of water 800 ft. in diameter 70 ft. high. Much the same methods were used by Pasley a year or two later in destroying the *Royal George*, except that electricity was used for firing the charge.

The Greenwich Lunar Observations

"ON May 31, 1838, the Treasury assented to the undertaking of the Lunar Reductions and allotted £2,000 for it; preparations were made, and in the autumn 7 computers were employed upon it" (Airy). "The reduction of the Greenwich lunar observations from 1750 to 1830," says Grant, "was undertaken at the public expense in consequence of a representation to that effect having been made to the Government by the British Association, agreeably to a suggestion of Sir John Lubbock's on the occasion of the meeting of the Association, which was held in Liverpool in 1837. The organization of the plan of reduction, as well as the superintendence of its execution, was confided to Mr. Airy. In consequence of the multitude of inequalities by which the moon's motion is affected, the undertaking was one of stupendous magnitude. In order to form some idea of the labour expended in its execution, it may be mentioned that upwards of 8,000 places of the moon were deduced from the observations, and compared with the corresponding places calculated from the tables. . . . The calculations connected with this great undertaking were superintended by Mr. Hugh Breen, who had the melancholy satisfaction of just living to see its completion. Mr. Airy, who bears honourable testimony to his skill and accuracy, states, at the beginning of the first volume of the published results, that after a short illness he expired on the morning of April 1, 1848, only a few hours having elapsed after the last supplementary tables had been sent to the press."

Influence of Nitrogen on Growth of Plants

AT a meeting of the Royal Society on May 31, 1838, Robert Rigg read a paper entitled "An Experimental Inquiry into the Influence of Nitrogen on the Growth of Plants". After alluding to a previous paper describing the chemical changes which occur during the germination of seeds, the author proceeded to trace the connexion between the phenomena exhibited during the growth of plants and the direct agency of nitrogen. The results of his experiments were arranged in tables indicating in about 120 different vegetable substances, not only the quantities of carbon, oxygen, hydrogen, nitrogen and residual matter, but also the quantity of nitrogen in each compound, when compared with 1,000 parts by weight of carbon in the same substance. The most important tables were those which exhibited the chemical constitution of the germs, cotyledons, and rootlets of seeds; the elements of the roots and trunks of trees, and the character of the various parts of plants, especially of the leaves at different periods of their growth. From his observations it appeared that nitrogen and residual matter are invariably the most abundant in those parts of plants which perform the most important offices in plant physiology, and the author was disposed to infer that nitrogen (being the element which more than any other is permanent in its character) when combining with residual matter, is the moving agent, acting under the living principle of the plant, and moulding into shape the other elements.

Spanish Bells

THE issue of the *Gentleman's Magazine* for May 1838 contains the following information: "In consequence of the difficulties to which the existing

government of Spain has been reduced in the war with Don Carlos, a large quantity of bells, which were the property of the convents and were transferred from them for the relief of the Queen's cause, were sent to Marseilles and sold as old metal. About sixty were purchased by an American gentleman and shipped to New York, where the most experienced bell-founders examined them and pronounced that they are such that cannot be made in America, nor probably anywhere at this time. It is well known that the ancient Spanish bells and indeed all the old bells cast in Catholic countries were considered as sacred; the more precious their metal, the greater their sanctity, and nearly all of them are thought to have more or less silver in their composition. The art of compounding silver with the other metals entering into the composition of bells is now entirely lost. The tones are said to be inimitably beautiful; and it is stated that one of these bells weighing 100 pounds has as much power and strength of tone as an ordinary bell weighing 300. They weigh from 100 to 1700 pounds each; and are often highly ornamented with figures of the Cross, royal Arms of Spain and various devices *in alto relievo*. After being a certain time on view at New York, they were dispersed by public sale, and will now be scattered about in every quarter of the States. . . . The largest weighing 1700 pounds is already doing duty on the top of the New York City Hall."

University Events

BELFAST.—Mr. A. H. Naylor has been appointed professor of engineering as from October 1, in succession to Prof. F. Hummel, who is retiring. Mr. Naylor is at present research officer of the Institution of Civil Engineers.

LEEDS.—Dr. D. T. A. Townend has been appointed Livesey professor of coal gas and fuel industries, to take office from October next, in succession to Prof. J. W. Cobb (see p. 964).

LONDON.—Prof. H. H. Read has been appointed, as from January 1, 1939, to the University chair of geology tenable at the Imperial College of Science and Technology. Since 1931 he has been George Herdman professor of geology in the University of Liverpool.

Dr. G. R. de Beer has been appointed to the University readership in embryology tenable at University College. For the last eleven years he has been Jenkinson lecturer in embryology and senior demonstrator in zoology and comparative anatomy in the University of Oxford.

The title of professor of natural philosophy in the University has been conferred on Dr. Herbert Dingle, in respect of the post held by him at the Imperial College—Royal College of Science.

The following doctorates have been conferred: D.Sc. in biochemistry on W. T. J. Morgan, of Queen Mary College, Lister Institute of Preventive Medicine, and West Ham Municipal College; D.Sc. in botany on A. E. Muskett, of the Imperial College—Royal College of Science; D.Sc. in chemistry on H. N. Rydon, of the Imperial College—Royal College of Science.

The Dunn exhibitions in anatomy and physiology for 1938 have been awarded to Mr. S. D. V. Weller (of University College) and Mr. J. W. L. Doust (of King's College) respectively.

Societies and Academies

London

Royal Society (*Proc.*, B, **125**, 187–290, April 27, 1938).

D. KEILIN and T. MANN: Polyphenol oxidase: purification, nature and properties.

J. MELLANBY and C. L. G. PRATT: The coagulation of plasma by trypsin.

A. S. PARKES and I. W. ROWLANDS: Studies on the hypophysectomized ferret. (10) Growth and skeletal development.

E. C. DODDS and W. LAWSON: Molecular structure in relation to œstrogenic activity. Compounds without a phenanthrene nucleus.

P. N. MARTINOVITCH: The development *in vitro* of the mammalian gonad: ovary and ovogenesis.

H. G. SMITH: The receptive mechanism of the background response in chromatic behaviour of Crustacea.

H. WARING: Chromatic behaviour of elasmobranchs.

LORD ROTHSCHILD: The polarization of a calomel electrode.

Dublin

Royal Irish Academy, April 25.

A. FARRINGTON: The glaciers of Mount Leinster and Blackstairs Mountain. The moraines of the local glaciers are described and their relations to one another discussed. The level of the snow-line during the late glacial period is estimated at 1,650 feet O.D.

Edinburgh

Royal Society, May 2, 1938.

R. CARRICK: The life-history and development of *Agriolimax agrestis* L., the grey field slug. Seasonal activity, copulation, oviposition, hatching and growth of *Agriolimax agrestis* are dealt with. There is no seasonal sexual cycle, but reproductive activity is controlled directly by weather conditions and is most evident during August-November. Under field conditions, the incubation period varies from 21 to 96 days. Embryological points of interest are fusion of the third tentacles, development of large contractile sacs, direct transition of blastopore into mouth, and the composite structure of larval nephridia from mesodermal bands and ectodermal invaginations. The structure and function of the modified larva, associated with development within the albuminous egg-capsule on land, are compared with less specialized gasteropods.

EDITH A. T. NICOL: The brackish-water lochs of Orkney. The brackish-water lochs of Orkney are the only Scottish localities where *Neritina fluviatilis* L. is found. The Loch of Stenness is entered by spring tides and has a salinity varying between 10·2 and 26·8 per cent. Its fauna and flora are mainly brackish in character, but many marine forms occur. The Loch of Stenness flows into the other and has a low salinity, 0·8–4·3 per cent, and many freshwater species occur along with brackish ones. The calcium contents in both lochs varies between 56 and 139 mgm. per litre, which partially accounts for the presence of *Neritina*.

MARIE E. CAMPBELL: An investigation of the Mucorales in the soil. Fifteen soil samples were taken

from seven distinct soil types and the species of *Mucor* were isolated in pure culture. The results show that there is no well-marked *Mucor* association for the soil types. Certain species such as *Mucor hiemalis* and *M. racemosus* occur in almost all soils. The proportion of positive to negative forms of *M. hiemalis* in the soil was found to be 25 : 4. By experiment it has been shown that the positive hyphæ of *M. hiemalis* are more resistant to drying than the negative hyphæ. Hybrid zygospores have been obtained between different species of the same genus and also between different genera of the Mucorales.

D. MEKSYN: Green's function for an ellipse and its application to the motion of a point vortex. Green's Function for the space external to an infinitely long elliptic cylinder, and for the space enclosed between two such confocal cylinders are evaluated. The stream lines and the motion of a rectilinear vortex outside an elliptic cylinder are found.

Paris

Academy of Sciences, March 28 (*C.R.*, **206**, 961–1064).

CHARLES EUGÈNE GUYE: Relativity, resonance and molecular diffusion.

JEAN BOSLER: Earth currents and magnetic disturbances. From a study of the records of the Parc Saint-Maur Observatory it is shown that the variations of the N–S earth currents follow those of the magnetic declination and those of the E–W current those of the horizontal force. A general principle is enunciated: when two phenomena are such that the curves which represent them as a function of the time are parallel, the two are related by a law of proportionality.

JEAN VILLE: A continuous game. Discussion of a problem in probability.

ARYEH DVORETZKY: The abscissæ of holomorphy and meromorphy of analytical functions represented by Dirichlet series.

JEAN LEGRAS: An integral equation with principal part.

HUBERT DELANGE: The domain of absolute convergence of multiple series of powers.

V. A. KOSTITZIN: The singular points of the differential equations of the problem of natural selection.

CHI TAI CHUANG: The behaviour of a holomorph function in a circle.

MICHEL KIVELIOVITCH: Hydrodynamic equations and quantic statistics.

RENÉ ANTHOUARD: Some characters of sparks submitted to an air current.

MLLE. EDITH COUILLAUD: Concerning physical tests for cement. Tests on cement in different laboratories, made in every detail in accordance with a rigorous specification, show differences of 4–15 per cent. Replacement of hand mixing by mechanical mixing in the preparation of the test pieces is suggested as likely to lead to greater concordance in the results.

PIERRE DIVE: Analyticity of the square of the angular velocity of a fluid star.

SANTIAGO ANTUNEZ DE MAYOLO: The principle of the critical velocity in the materialization of the photon.

GÉRARD PETIAU: A form of the solutions of the Dirac equations and the equations of the photon.

JEAN GUASTALLA: A new technique for the measurement of very small surface pressures.

PIERRE VERNOTTE: The practical determination of the relative values of the thermal conductivity of metals.

JEAN SAVARD and MARC DE HEMPTINNE: The simple critical potentials of carbon monoxide.

ROBERT GUILLIEN: The dielectric constant of carbon disulphide at a low temperature. The experiments of Mazur indicated an anomaly for the dielectric constant at about − 90° C., pointing to the existence of two different liquid states of carbon disulphide. The author has been unable to confirm this; provided that the liquid is efficiently stirred no anomaly exists between + 20° C. and − 110° C.

BRUNO PONTECORVO: The diffusion of monokinetic neutrons by protons.

RENÉ AUDUBERT and J. MATTLER: The influence of vapours on the curve of spectral sensibility of photo-electric counters.

PIERRE LAMBERT and JEAN LECOMTE: The application of infra-red absorption spectra to the determination of the position of the ethylene linkage in a fatty carbon chain.

FRANÇOIS GANS: The spectral distribution of the white light obtained by electrical stimulation of xenon. The tubes studied contained either xenon or a mixture of xenon and neon. The energy distribution of the continuous spectrum was very nearly the same as that of a black body at 3,800° C. The lines showing were xenon lines only; no neon lines were seen.

JULES FARINEAU: The *L* spectrum of iron.

MARCEL FRILLEY: The spectrography by diffraction of the γ-rays of actinium and of its derivatives.

ANDRÉ MOUSSA and MLLE. HÉLÈNE LAURENT: The periods of disintegration of the radio-silvers.

YVES DEUX: The semihydrobenzoin transposition of phenylmethylvinylglycol by dehydration and by the isomerization of the corresponding epoxide.

MARCEL TUOT: The secondary reactions observed in the course of the organo-magnesium condensation of ketones in the fatty series. Study of two secondary reactions produced by the enolization of the ketone by the action of the Grignard reagent.

FRANÇOIS SALMON-LEGAGNEUR: A new structural isomer of campholic acid: β-campholic acid.

JEAN DÉCOMBE and CLÉMENT DUVAL: The double formula of organo-magnesium compounds. Support for the hypothesis of the double formula for organo-magnesium compounds is given by the formation of a zinc-magnesium complex compound by the action of a zinc-magnesium alloy on methyl iodide in ethyl acetate solution.

MAURICE MÉTRA, LUCIEN LESAGE and FERNAND DESCATOIRE: The detection of small quantities of isopropanol in alcohols. The method described has been applied to the examination of more than a hundred specimens of ethyl alcohol from various sources: in no case was isopropyl alcohol detected.

RAYMOND PAUL: The influence of the nature of the cycle on the physical properties of some 1,4 and 1,5 isomeric epoxides.

PAUL GAUBERT: Role of the foreign matter in the structure of liquid crystals.

JACQUES FLANDRIN: The relations of the deposits with Medjano-Numidian facies and of the Oligocene with Lepidocyclines in the littoral and

tellian chains of the Department of Algiers and the adjacent regions.

JEAN CUVILLIER : The presence of Miogypsines in the Egyptian Miocene.

JEAN BRICARD : Study of the coronas of the natural fogs at the summit of the Puy de Dôme.

ANDRÉ MIRIMANOFF : Ascorbic acid and the carotenoid pigments. The meaning of the Molisch reaction and attempt at the localization of ascorbic acid.

JOSEPH LEFÈVRE : Polarity problems produced on plant cuttings by various substances.

VICTOR VINCENT, JEAN HERVIAUX and YVES COIC : Liming acid soils by natural limestones and agricultural lime.

GEORGES DELOFFRE : The influence of some organic acids on nuclear metabolism and on amylogenesis in the lupin.

MAURICE PIETTRE : Mechanical treatment of defibrinated blood or blood rendered incoagulable.

MME. ANDRÉE DRILHON : The alexic power the sera of the Teleosteans.

MME. YVONNE JÉROME-LÉVY : Cultures of the lower plants such as *Aspergillus niger*, *Aspergillus repens* and *Penicillium glaucum* in the presence of carbon. A marked increase in the development of *Aspergillus niger* is shown when carbon is added to the culture fluid (Raulin). With *Aspergillus repens* there is a slight increase of growth ; no increase of weight is shown by *Penicillium glaucum*.

MME. PAULETTE CHAIX : The influence of treated cystine on the Pasteur effect in washed *Propionibacterium pentosaceum*.

JEAN LAVOLLAY and MME. FRANÇOISE LABOREY : The circumstances in which yellow pigments appear in the culture fluid of *Aspergillus niger*. The production of the yellow pigment is due to a deficiency of magnesium.

ANDRÉ DONATIEN and FERNAND LESTOQUARD : The evolution of the agent of Rickettsian conjunctivitis of ruminants.

MICHEL MACHEBŒUF, JOSEPH DIERYCK and MME. BLANCHE DIERYCK : The comparative study of the phagocytal reaction of guinea pigs with intraperitoneal injection of dead tubercle bacilli and of bacilli partially deprived of lipids (chemicovaccine).

DANIEL FLORENTIN : The coli bacillus flora of cheese and food poisoning. The presence of coli bacilli in various cheeses was proved, one of which, containing the largest number of bacilli per gram, had been the cause of food poisoning. It is regarded as rather alarming that, whilst the coli bacillus is prohibited in water, oysters, etc., the consumption of certain cheeses leads to the absorption of considerable quantities.

SPIRO LIVIERATO, MARINO VAGLIANO and NEARCHOS KOKARAKI : Two new antigens for the sero-reaction of paludism according to Henry's method.

Moscow

Academy of Sciences (*C.R.*, 18, No. 3, 1938).

I. M. RAPOPORT : The inverse problem of the variation calculus.

A. BERMANT : Some properties of regular functions.

M. IELCHIN : Problem of oscillation for the linear differential equations of second order.

E. R. MUSTEL : The problem of radioactive equilibrium of a stellar atmosphere when the coefficient of absorption depends on the frequency.

V. STEPANOFF : The definition of probability of stability.

M. BEBOUTOFF : Dynamic systems which are stable in the sense of Liapounoff.

I. MALKIN : On the stability of movement in the first approximation.

I. MALKIN : Generalization of the fundamental theorem of Liapounoff on the stability of movements.

P. NOVIKOFF : The inverse problem of the potential.

B. G. ŠPAKOVSKIJ : Propagation of supersonic waves in liquids. (1) Dispersion in some pure liquids and aqueous solutions. (2) Dispersion in acetic acid.

E. REICHRUDEL and G. SPIVAK : Influence of magnetic field on the potential gradient in plasma.

A. FILIPPOV, A. GDANOW and I. GUREVICH : The disintegration of nuclei by cosmic rays.

A. A. TRAPEZNIKOV and P. REHBINDER : Mechanical properties (viscosity, rigidity and strength) of adsorption layers and their relation to the area per molecule and nature of underlying liquid.

A. A. SAPEGHIN : The course of the development of wheat ear.

G. N. EREMEJEV : Drought resistance and dehydration resistance of plants.

G. ABOLINA : The significance of mineral elements in the process of vernalization.

M. S. JAKOVLEV : The endosperm structure of the principal selection varieties of wheat of the U.S.S.R.

A. A. YATSENKO-KHMELEVSKY : The discoloration of beech wood.

L. N. ŽINKIN : Stimulation of metamorphosis in Ascidian larvæ.

Rome

National Academy of the Lincei (*Atti*, 26, 129–191 ; 1937).

G. FANO : Observations on some finite geometries (2).

O. SCARPA : Formation of pseudo single crystals in the electro-deposition of copper.

C. AGOSTINELLI : Resolution by means of definite integrals of the equation

$$\frac{\delta^2 u}{\delta x^2} + \frac{\delta^2 u}{\delta y^2} + \frac{\delta^2 u}{\delta z^2} + \frac{1}{x}\frac{\delta u}{\delta x} = f,$$

and a problem analogous to that of Dirichlet for a hemispherical field.

G. GHERARDELLI : Cayley groups of points above an elliptical curve.

I. POPA : Projective-differential geometry of singularities. The point of inflexion of any surface whatsoever.

M. SCHÖNBERG : The function $\delta(x)$ of Dirac (2).

A. TERRACINI : A possible particularity of the principal lines of a surface (2).

E. MEDI : Researches on the ionization produced by the evaporation of water.

R. MANZONI ANSIDEI : Raman spectrum of hydrocarbons with condensed nuclei (2). 9-10-dihydroanthracene, acenaphthene, fluorene.

G. CHARRIER and M. IORIO : 8-substituted 2-3 pyridinotriazoles.

G. TEDESCHI : Rate of dissolution of lead in acids (2).

G. SCOZ and E. TRIA : Ascorbic acid content of the frog's liver under various experimental conditions.

E. TRIA : Electrometric determination of peptic activity.

Forthcoming Events

Tuesday, May 31

FUEL RESEARCH STATION, Greenwich, S.E.10, at 2–6.—Annual Visitation.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Prof. F. Weidenreich: "Did *Sinanthropus* Practise Cannibalism?"

INSTITUTION OF GAS ENGINEERS, May 31–June 3.—Annual General Meeting.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS, June 4–7.—Annual Conference to be held at Leeds.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER IN CHEMISTRY in the Bradford Technical College—The Principal (May 31).

GEOLOGISTS in the Geological Survey and Museum of Practical Geology—The Director, Geological Survey and Museum, Exhibition Road, South Kensington, S.W.7 (May 31).

LECTURER IN ELECTRICAL ENGINEERING in the Carlisle Technical School—The Director of Education, Education Offices, Fisher Street, Carlisle (June 1).

LECTURER (woman) IN MATHEMATICS in the Bingley Training College—The Education Officer, County Hall, Wakefield (June 2).

LECTURER (woman) IN MATHEMATICS in the Avery Hill Training College—The Education Officer (H. 2/1), County Hall, London, S.E.1 (June 8).

LECTURERS IN BUILDING, PRODUCTION ENGINEERING AND WORKSHOPS PRACTICE in the Central Technical College, Birmingham, 1—The Principal (June 11).

ANALYTICAL CHEMIST in the Government Chemical Laboratories, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, London, S.W.1 (June 11).

PRINCIPAL of the Scarborough Evening Institutes—The Secretary, Education Offices, County Hall, Northallerton (June 11).

ASSISTANT LECTURER IN MATHEMATICS in the Royal Holloway College, Englefield Green, Surrey—The Principal (June 11).

DEMONSTRATOR IN CIVIL AND MECHANICAL ENGINEERING in the University of Leeds—The Registrar (June 13).

DEMONSTRATOR IN BACTERIOLOGY in the University of Leeds—The Registrar (June 13).

GENERAL SECRETARY of the Society for the Protection of Science and Learning—Prof. C. S. Gibson, Guy's Hospital, London, S.E.1 (June 15).

CURATOR of the Verulamium Museum—The Town Clerk, Municipal Offices, 38 St. Peter's Street, St. Albans (June 28).

MEDICAL SECRETARY AND REGISTRAR to the Clinical Cancer Research Committee of the British Empire Cancer Campaign—The General Secretary, 11 Grosvenor Crescent, London, S.W.1 (June 30).

LECTURER IN MECHANICAL ENGINEERING in the School of Engineering at Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (July 1).

PRINCIPAL of the Imperial College of Tropical Agriculture, Trinidad—The Secretary, Imperial College of Tropical Agriculture, 14 Trinity Square, London, E.C.3 (July 9).

PROFESSOR OF METALLURGY AND ASSAYING AND DIRECTOR OF THE MINERALS RESEARCH LABORATORY in the University of the Witwatersrand—The Secretary, South Africa House, Trafalgar Square, London, W.C.2 (July 30).

ASSISTANT KEEPER ON THE HIGHER TECHNICAL STAFF OF THE INDUSTRIAL ENGINEERING DIVISION of the Science Museum—The Director, Science Museum, South Kensington, London, S.W.7.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial College of Science and Technology. Warington Smyth Memorial Lecture, 1938: Metal-Mining Enterprise. By Prof. S. J. Truscott. Pp. 38+2 plates. (London: Macmillan and Co., Ltd.) 1*s*. net. [45

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 9, No. 3, December 1937. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies. Pp. v+191–280. (London: H.M. Stationery Office.) 4*s*. 6*d*. net. [55

Air Ministry: Meteorological Office. Averages of Humidity for the British Isles. (M.O.421.) Pp. 42+1 plate. (London: H.M Stationery Office.) 9*d*. net. [55

City and County of Bristol: Bristol Museum and Art Gallery. Report of the Committee for the Two Years ended 31 December 1937. Pp. 40+8 plates. (Bristol: Museum and Art Gallery.) [55

Guide to the Argyll National Forest Park. Edited by Prof. John Walton. Pp. 29+2 plates. (London: H.M. Stationery Office.) 6*d*. net. [55

Other Countries

Tanganyika Territory: Department of Lands and Mines, Geological Division. Short Paper No. 17: An Explanation of Degree Sheet No. 52 (Dodoma). Compiled by F. B. Wade and F. Oates. Pp. 60+4 plates. (Dar es Salaam: Government Printer.) 3*s*. [55

India Meteorological Department. Scientific Notes. Vol. 7, No. 75: Squalls at Karachi. By P. R. Krishna Rao. Pp. 75–101+6 plates. (Delhi: Manager of Publications.) 1·14 rupees; 3*s*. 3*d*. [55

Government of Iraq. Ministry of Defence: Meteorological Service. Annual Report of the Director, No. 1: Year ending 31st March 1937. Pp. ii+8+11+2 plates. (Baghdad: Government Press.) [55

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